BUROHAPPOLD ENGINEERING

New Tottenham Hotspur Football Club (THFC) Stadium

Operational Waste Management Strategy

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Glossary

Term	Definition
AD	Anaerobic Digestion
C&I	Commercial & Industrial
DEFRA	The Department of Environment Food and Rural Affairs
EVs	Electric Vehicles
FM	Facilities Management
LBH	London Borough of Haringey
MSW	Municipal Solid Waste
MRF	Material Recovery Facility
NFL	National Football League
NLWP	North London Waste Plan
OWMS	Operational Waste Management Strategy
SWMP	Site Waste Management Plan
THFC	Tottenham Hotspur Football Club
UK	United Kingdom
UTC	University Technical College
Waste Hierarchy	
WEEE	Waste Electrical and Electronic Equipment
WTN	Waste Transfer Note

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1 Introduction

An Operational Waste Management Strategy (OWMS) is required to support the detailed planning application for the new 61,080 seat Tottenham Hotspur Football Club (THFC) Stadium in Tottenham, North London. The stadium development includes a mixed retail and leisure venue known as the THFC experience, a north-east office building, and a large public square (which may contain spectator screens for members of the public to watch events taking place within the stadium).

Tottenham University Technical College (UTC), is located immediately north of the stadium. The UTC is currently operational, although it will take approximately five years to reach full capacity. Currently, UTC waste is being collected by the council via kerbside collection. THFC is a co-sponsor of the UTC and has agreed that once the new stadium is operational, the waste generated within the UTC will be managed by THFC.

All waste generated from these land uses, with the exception of the north-east office building which will manage its own waste, is to be managed by THFC and this OWMS outlines how the stadium team will go about managing this waste. This document will support the planning application for the new THFC stadium which includes the THFC experience and public square and will be submitted to the London Borough of Haringey (LBH)

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1.1 Aims and aspirations

The management of solid waste is an important element to consider as buildings are designed. Planning for future operational waste management ensures that a building will be able to operate efficiently and sustainably while minimising the impacts on the designed requirements building performance and site users. Good waste management will be essential, ensuring safe operational practice throughout the development. Specifically, by allowing THFC Facilities Management (FM) to collect, store, recycle, re-use and dispose of waste quickly and efficiently and in a discreet manner in line with THFC Waste Management Policy and the waste hierarchy as shown in **Figure 1.**

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Figure 1: The Waste Hierarchy

01 Minimise the amount of waste produced and avoid producing waste in the first instance

02 Re-use items as many times as possible

03 Recycle what you can once you have re-used it and it is no longer able to be used or is no longer needed

04 Turn waste materials into a new product where possible i.e. the generation of waste from energy

05 Dispose of what is unable to be recovered in a responsible way

Waste management operations will need to be hidden from fans to ensure that they do not interfere with the operations of the stadium or lesser the enjoyment of the fans. Of most importance is the need to develop a waste strategy that works with an effective logistics strategy to allow for rapid venue turnaround times. This is essential, particularly in the stadium which will need to be rapidly cleared of waste during and after football games and events that take place.

In summary, the aims to be achieved during the formulation of the OWMS are to:

- Provide an estimate of anticipated waste generation for the stadium, THFC experience, UTC and public square;
- Provide guidance on waste management to ensure that adequate spatial provision for clean, hygienic and efficient storage and collection of waste is incorporated into the design. This is essential for successful operation and for the aesthetics of development;
- Enable the FM team to manage the different types of waste quickly, sustainably and efficiently and in a discreet manner;
- Ensure that national and local waste management targets as well as any other client aims and aspirations are achieved. These targets, aims and aspirations are detailed in full in **Appendix A**;
- Ensure that waste management practices are efficient, reduce operational costs while aiming to recover economic value from waste whilst championing environmental protection principles;
- Learn from the existing THFC stadium and other London stadiums , to identify the issues that the FM team working within similar venues are facing, how this is affecting the efficiency of waste management operations on a day to day basis. This information will aim to consider any lessons learnt and any improvements to operations that could be made and designed into e new THFC stadium. The detailed findings of the study are presented in **ppendix B**; and
- Look at initiatives to reduce the quantity of waste produced and maximise recycling rates at the development. A summary of the possible initiatives that could be explored are outlined in **Appendix C**.

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2 Existing Stadium Waste Generation

Discussions within THFC have been undertaken to understand the main issues that are currently restricting the stadium's FM team's ability to collect, manage and dispose of waste effectively. Existing recycling rates are poor and THFC staff acknowledge that more could be done to manage waste in a more efficient and sustainable way, although there is insufficient waste infrastructure within the existing building to facilitate change.

A review of the ACM Environmental Services[1] waste collection logs for the existing stadium has been undertaken. The number of units (wheeled bins or containers) collected rather than the tonnage is currently recorded. In order to provide data for total volumes of waste, create metrics and to compare these with the new stadium . ACM estimates weights by converting these units to tonnage by using their own assumptions for the waste type that is collected and the disposal container that is used. Therefore, whilst the data reviewed is useful it should be treated as an indication only of the tonnage that the site produces. A summary of existing waste management practices at the existing THFC stadium is provided below:

- Five waste streams are currently collected: clinical waste, dry mixed recyclables (compacted card, paper, cans and plastic), residual waste, glass (uncrushed), confidential waste and grass waste;
- Current recycling practices are poor. 11.4% of waste produced by weight is categorised as recyclables (glass, confidential waste and dry mixed recyclables). 25.7% of the waste generated is grass and 62.9% is residual waste;
- Contamination of recyclable waste is a significant issue for the stadium FM team and
- The amount of waste produced fluctuates significantly based on the number of home games. There is a peak before and after Christmas, relating to the large number of games within a short period of time.

The amount of waste produced at the existing stadium during the period 01/08/2013 to 01/08/2014 is presented in **Table 1.** This has been obtained from the ACM waste collection logs and from the THFC official website. This also allows for the creation of a number of metrics which in turn can be used to predict future waste generation levels within the new stadium.

Table 1: Existing Stadium Waste Generation

Period	No. of games	Recyclables (tonnes)	Grass cuttings (tonnes)	Residual waste (tonnes)	Total (tonnes)	Average waste per game	Average waste per fan per game
August 2013 to August 2014	29	83	188	460	731	18.7	0.546kg

According to the THFC website, 29 games (including pre-season friendlies, Premier League, UEFA and FA and League Cup games) were played during the period 01/08/2013 to 01/08/2014. During this time, fan numbers ranged from 23,101 to 36,102. The average number of fans per game was 34,243 (the stadium is typically 94% full during the season). Based on this data it is estimated that 18.7 tonnes of waste is produced on average per game. It should be noted that this figure excludes grass waste. Assuming that 18.7 tonnes of waste was produced per game when 34,243 fans were in attendance, it is estimated that each fan is producing 0.546kg of waste per game.

[1] Current waste management contractor for THFC

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3 Anticipated Waste Generation and Bin Numbers

3.1 Waste Generation

In order to determine spatial requirements for the management of waste in the new stadium, outline waste generation rates have been estimated. This is based on the Populous area schedule, drawings for the stadium and a umber of assumptions (laid out via two options) which are outlined below.

Option 1 – Site wide metric: This methodology involves the calculation of waste for the stadium using a site wide metric waste generation rate of 0.546kg per fan per game based on existing THFC waste data. This all-encompassing generation rate includes waste generated within the player and media facilities, offices, kitchens, bar and hospitality areas and the THFC experience). Waste generated from the pitch, UTC, public square, north-east building, National Football League (NFL) games and concerts were then calculated separately to give a total anticipated annual tonnage.

Option 2 – Land use metrics: This methodology involves using a waste generation rate based on data obtained from Wembley Stadium and other specific land use metrics (i.e. kitchens, offices etc.). The figure for fan only waste take into account the amount of waste produced during games and does not consider other stadium operations. Waste generation rates for five events a similar stadium that took place ranged from 0.21kg and 0.37kg per fan per game, with the average generation rate calculated at 0.25kg per fan per game. Waste generation rates obtained from waste audits or published documents in similar landuses s were then used to calculate anticipated waste for the remainder of the stadium facilities including player and media facilities, THFC experience, kitchens, offices, retail etc. as well as the pitch, UTC, public square, north-east building, and anticipated NFL games and concerts.

The amount of waste anticipated using each option was broadly similar. Option 1 anticipated 1,446 tonnes per annum and Option 2 anticipated 1,283 tonnes per annum. It was considered more accurate to use the waste generation rate of 0.546kg per fan per game based on the existing THFC waste data and therefore Option 1 was deemed most appropriate in sizing waste storage needs. This is also the most conservative approach. The waste generation estimates provided in **Table 2** are high level and are based on the following assumptions which are subject to change:

- Average recycling target of 50%;
- A generation rate of 0.546kg per fan per game for the stadium. This accounts for waste generated within the player and media facilities, offices, THFC experience, kitchens, bar and hospitality areas;
- The 61,080 seats within the stadium will all be full. This is a conservative assumption;
- A generation rate of 99.5kg per student per year for the UTC. This accounts for all waste generated within the UTC. It is anticipated that the UTC will accommodate 900 students;
- The amount of grass waste produced will not change as the size of the pitch will be the same in the new stadium;
- The public square will contain ten 90 litre bins which will be serviced (on average) once a day;
- The north-east building offices will accommodate up to 116 employees;
- Two NFL games with a full stadium capacity of 61,080 will be hosted per year in autumn; and
- Six concerts with an average capacity of 55,000 will be hosted per year which will take place between May and July.

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Table 2: Estimated New Stadium and Associated Facilities Waste Generation

Land use	Floor area m²	Capacity	Estimated waste generation (kg/week)	Estimated waste generation (tonnes / year)
Stadium	127,181	61,080	18,599	967
Pitch	-	-	3,615	188
Public square	10,765	-	253	13
UTC	-	900	1,913	100
North-east Building	1,396	-	559	29
NFL games	-	61,080	1,283	67
Concerts	-	55,000	1,585	82
TOTAL WASTE			**27,808 kg**	**1,446 tonnes**

Outline waste generation calculations estimate that approximately 28 tonnes of waste will be produced per week with annual waste generation likely to be in the region of 1,446 tonnes.

Consideration has been given to a worse-case scenario in terms of waste generation within the stadium. This would be a football match and an NFL game or other sporting event within one weekend. It has been calculated that up to 49 tonnes of waste could be produced in one weekend..

3.2 Outline Bin Numbers

An estimate of the total number of waste receptacles that will be required within the stadium has been calculated based on an anticipated collection frequency of three times a week for mixed recyclables, residual waste and organics. Other waste streams will be collected at less frequent intervals as and when they are needed. Presentation of bin numbers in this manner should be seen as a worst case scenario in terms of storage and collection. It also better visualises the volume of waste estimated to be produced in a development.

It is estimated that 68 x 1100 litre bins would be required for mixed recyclables[2] (including glass, plastics, paper and cardboard) and 21 x 1100 litre bins for residual waste. In addition, 40 x 240 litre bins for organic waste (this excludes grass waste) would be needed.

An additional 15 x 240 litre bins for grass waste would be required. These bins have been accommodated within the grounds keeping store within the north-east corner of the stadium.

The development of the strategy , in part aims to reduce these bin numbers and facilitate the most efficient form of management that can also deliver the sustainable targets that the stadium has aimed for. Management of Stadium Waste

[2] Recycling capture rates have not been applied at this high level stage of estimation.

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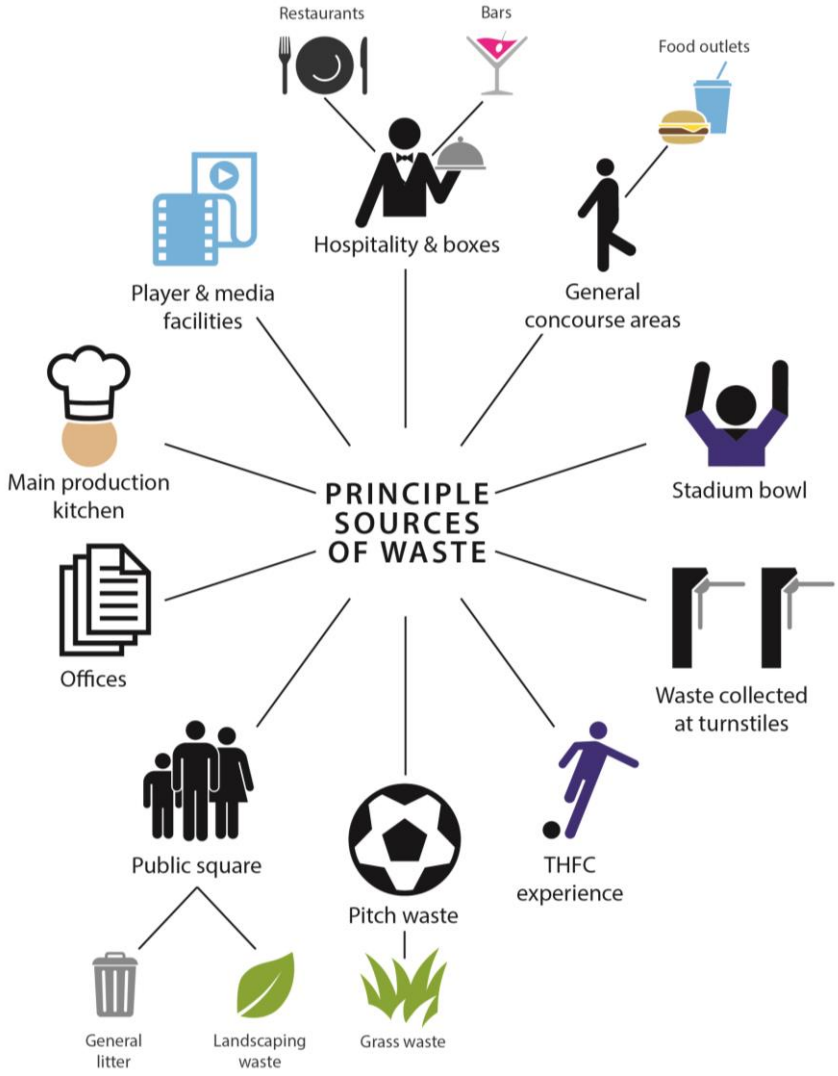
3.3 Waste Sources

The majority of the waste produced within the stadium will be generated sporadically, typically on a fortnightly basis when THFC home games are taking place or when an event such as a NFL game is taking place. This section outlines the main sources of waste and any specific considerations that need to be dealt with in the development of the waste management strategy.

Figure 2: Sources of Waste within the Stadium



3.4 Principle Waste Segregation Strategy

THFC will segregate waste at source (i.e. in the offices, hospitality and food outlets, kitchens, general concourse areas, player and media facilities, public square and within the THFC experience) into the following four main streams: residual waste, mixed recyclables (glass, paper, cardboard and plastics), organic waste (food and landscaping waste) and other waste as outlined in **Figure 3**. The 'other' waste stream is anticipated to include clinical and hazardous wastes, confidential waste, bulky and WEEE wastes which will arise in small quantities.

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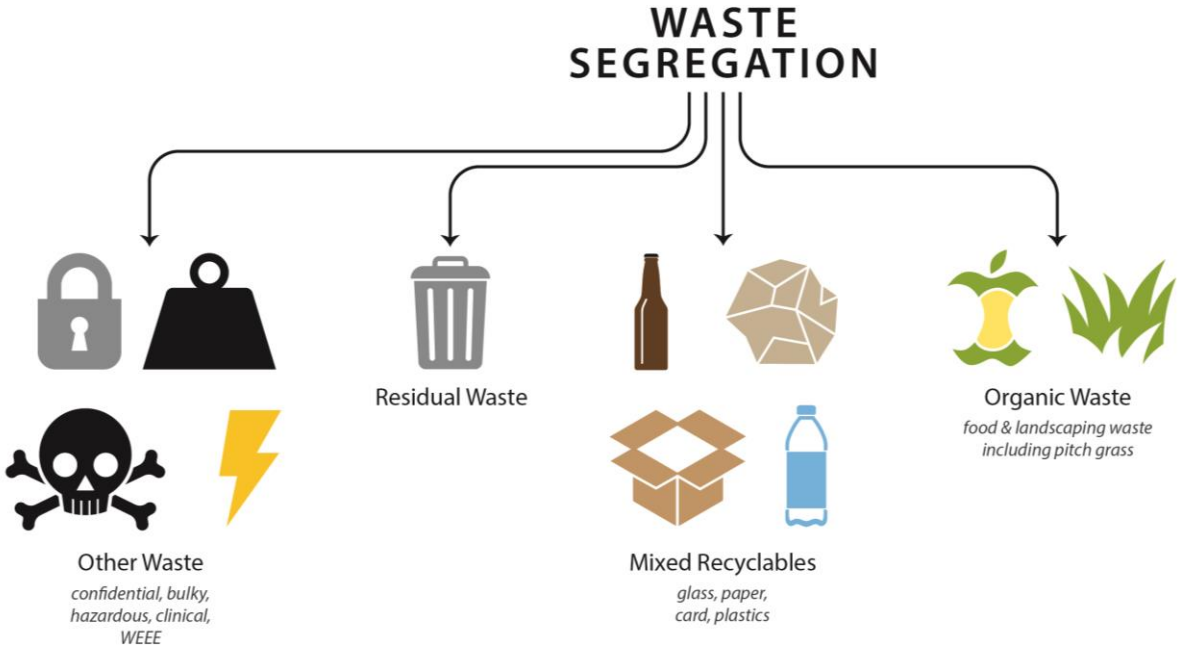
Figure 3: Segregation of Waste and Recyclables



3.5 Overview of Internal Waste Collection Strategy

Waste generated within the stadium will be managed by the FM team who will be responsible for the safe, hygienic and efficient transfer of waste from around the building to the dedicated waste and recycling area on Level 00, the main service level within the stadium. From here waste will be collected by external waste contractors. Detailed information on the waste and recycling area is provided in **Section 5**.

Intermediate waste storage rooms are located throughout each level of the stadium located to match those areas that will generate significant volumes of waste (Level 1 to 5 and Level 9). Rooms have been provided in general concourse and hospitality areas to enable waste to be held locally until it is less congested and can be moved to Level 00 at a convenient and safe time either during a game or once fans have left the stadium. This will facilitate the efficient management of waste on each level. It will ensure the number of journeys to Level 00 that the FM team has to make is minimised and there is reduced nuisance to fans, without limiting the ability of Level 00 to service the stadium. It is likely this method will also reduce the cost of servicing by reduce demand on FM staff numbers. As well as positioning the waste rooms as close as reasonably practical to the waste sources they have also been located to facilitate vertical movement via designated lifts that will transport waste to Level 00 to help facilitate rapid clearance. The lifts within the stadium which have been selected for the movement of waste are outlined in **Appendix D**.

Doorways to all intermediate waste rooms have a minimum of 1.5m width clearance to facilitate bin movement. All waste rooms will have adequate ventilation and lighting and are sealed to prevent vermin entering. Rubber buffers will be incorporated in all rooms and lifts that will be used to store waste to avoid damaging the walls.

The emergency route into the stadium is located next to the waste and recycling area on Level 00 and it is essential that this is maintained at all times. All waste receptacles and other equipment must remain in designated areas as to not impact the route entrance from the service yard.

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3.6 Key Areas - Collection and Storage of Waste

3.6.1 Turnstiles

Fans often attempt to bring banned food and drink items into the stadium, this in turn generates waste at the turnstiles. At the new stadium, the disposal of such items will be encouraged at the point of entry and facilitated for.

Fans will be encouraged to dispose of food purchased outside of the stadium before entering into temporary, wheeled bins. A three-stream (residual waste, recyclables and organic waste) system of honesty bins will be provided for, examples of which are shown in **Figure 4**,. This will give the stadium better control over the type of waste that is generated within the general concourse areas and the stadium bowl.

THFC are going to explore the use of detailing the types of waste that cannot be brought into the stadium on tickets and programmes and to encourage fans to use the appropriate bins and to recycle where possible.

Figure 4: Turnstile Bin Examples

The bins will be collected and removed following kick-off from the fan entrances using electric vehicles (EV) which will take waste to the lift on the podium at the north-east of the stadium which has direct access to the waste and recycling area. The bins are likely to be collapsible so that they can be folded away when they are not in use.

Figure 5: Waste Management at the Turnstiles

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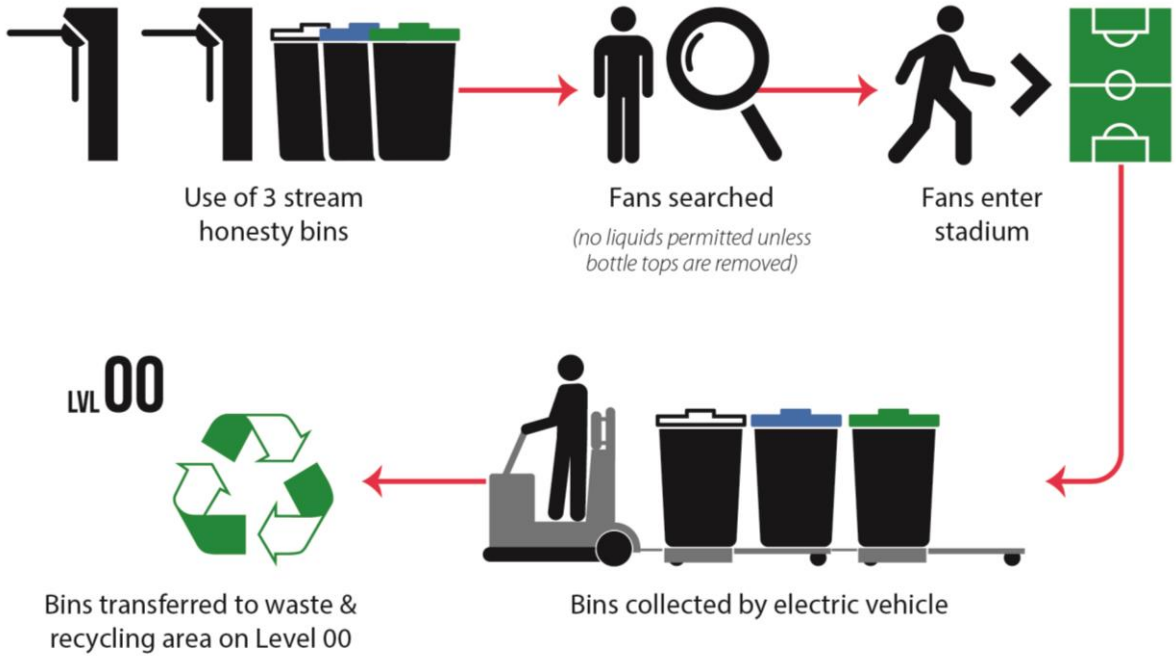
Use of 3 stream honesty bins
Fans searched
(no liquids permitted unless bottle tops are removed)
Fans enter stadium
LVL 00
Bins transferred to waste & recycling area on Level 00
Bins collected by electric vehicle

3.6.2 Stadium Bowl

The restrictions on the type of waste being brought into the stadium should mean that the vast majority of waste generated within the stadium bowl is that generated from what is sold to fans. Specifically, this will relate to food and beverage items sold to fans in concourse areas. As outlined in **Appendix C**, THFC are going to explore options in terms of catering but intend to homogenise waste streams by streamlining packaging used for food and drink served within the food outlets to reduce the number of waste streams and simplify the separation of materials such as cardboard and plastics.

It is recommended that no flyers are handed out during the game and that no free gifts, provided by sponsors are distributed. This would result in a large amount of unwanted items left behind at the end of matches.

No litter bins will be provided in the stadium bowl for security reasons, due to lack of space, poor visibility and limited use by fans. Waste within the stadium bowl will be collected in two ways following the final whistle; firstly a positive pick will be undertaken by FM operatives collecting recyclables with the remaining residual waste blown to the lowest point within the stadium and collected manually. The waste will be transferred to the waste and recycling area using an EV with subsequent bulking and sorting via a mini-Materials Recovery Facility (MRF). While collecting waste by hand is labour intensive, it is one of the most efficient methods for recovering recyclable materials.

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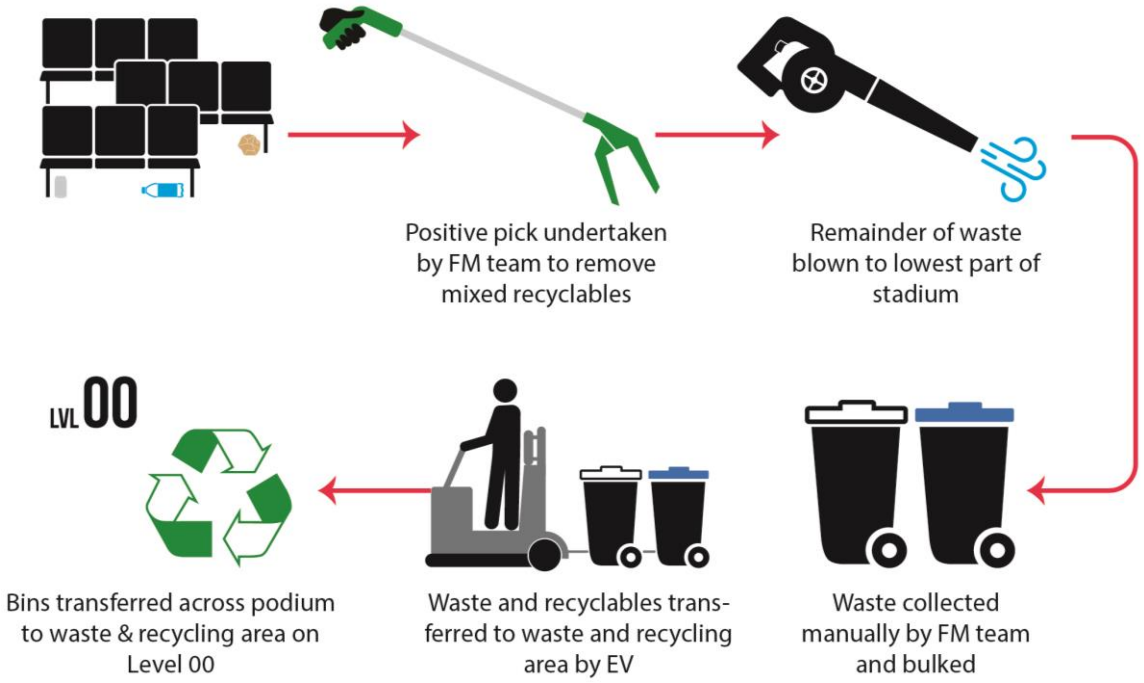
Figure 6: Waste Management within the Stadium Bowl


Positive pick undertaken by FM team to remove mixed recyclables
Remainder of waste blown to lowest part of stadium
LVL 00
Bins transferred across podium to waste & recycling area on Level 00
Waste and recyclables trans-ferred to waste and recycling area by EV
Waste collected manually by FM team and bulked

3.6.3 Basement

Limited waste is anticipated within the basement. Waste from the car park, storage and plant rooms will be deposited in small bins and collected locally by FM staff and transferred by hand to the waste and recycling area.

A furniture lift and store with access to Level 00 is provided beneath the north-east stand for the movement and storage of bulky waste. Bulky waste will be stored until a sufficient quantity has accumulated to warrant collection. THFC are keen to explore initiatives to sell or give old furniture which is still in a good condition to local businesses, charity or educational projects for re-use.

3.6.4 Level 00 (Service Level)

Level 00 is the main service level for the stadium and includes the main production kitchen and associated facilities, plant rooms, back of house and corporate circulation, staff, media and player facilities, parking, storage as well as the waste and recycling area with associated loading dock and service yard.

All waste generated will be transported from the upper levels by lift during and following a game via Level 00. There are two service lifts[3] within the stadium, one each within the eastern and western stands. These lifts will be used preferentially for the vertical movement of waste. The service lifts have access to Levels B1 up to Level 5 only. Flow route analysis undertaken has revealed that there would be huge pressure on these two service lifts to keep the building functioning and remove all waste from the upper levels independently. Drawings presenting the flow route analysis are provided in **Appendix E**. In the event of a breakdown or fault there would be too much pressure on the lift in either stand resulting in severe congestion on Level 00 (which is already anticipated to be congested on match days).

[3] Note, it is understood that Populous are exploring the opportunity to incorporate a dedicated service lift to the two southern cores which is intended to alleviate the pressure on the storage of waste at the concourses as these will be able to be used during the match

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Therefore, the use of public and disabled lifts, with access to all levels of the stadium, cannot be avoided. This will be managed by THFC to ensure spectator and visitor experience is not compromised. The lifts that are to be used for the movement of waste within the stadium are shown in **Appendix D**.

Once waste arrives on Level 00, it will be placed temporarily in a designated waste bay at the base of each of the lift cores that are being used for waste movement before being collected by the FM team using an EV and transferred to the waste and recycling area.

Figure 8: Example of Designated Waste Bays

The movement of waste on Level 00 will not be made through staff, media and player facilities within the west stand on match days. This area will be particularly busy and the club do not want waste movement through these public areas for aesthetic regions. Waste will either need to be transported from the goods lift within the west stand northwards to the waste and recycling area or from the lifts at the south-west of the stadium, through the car park and journey to the waste and recycling area via the east stand.

There are no intermediate waste storage rooms allocated on Level 00. The waste generated within the main production kitchen will be stored locally on match days in designated storage areas, until it is suitable for removal to the waste and recycling area by EV. The production kitchen will be the primary area in which food preparation is undertaken, as such a number of food dewaterer's or digesters will be provided to support the effective management of organic waste. The dewaterer's and digesters will significantly reduce the weight of organic waste produced whilst also supporting the recycling aspirations for the development.

In other areas, the anticipated quantities of waste are low and litter bins will be located in the media and player facilities and other offices and store rooms as appropriate, with waste collected by the FM team at the end of each day, or more frequently on match days and transported to the waste and recycling area.

Provision for the charging of EVs is provided at the south-east of the stadium on Level 00. The EVs will be used for the transport of both goods and waste. This area is located close to the service road access from Worcester Avenue and will allow EVs access to the podium level.

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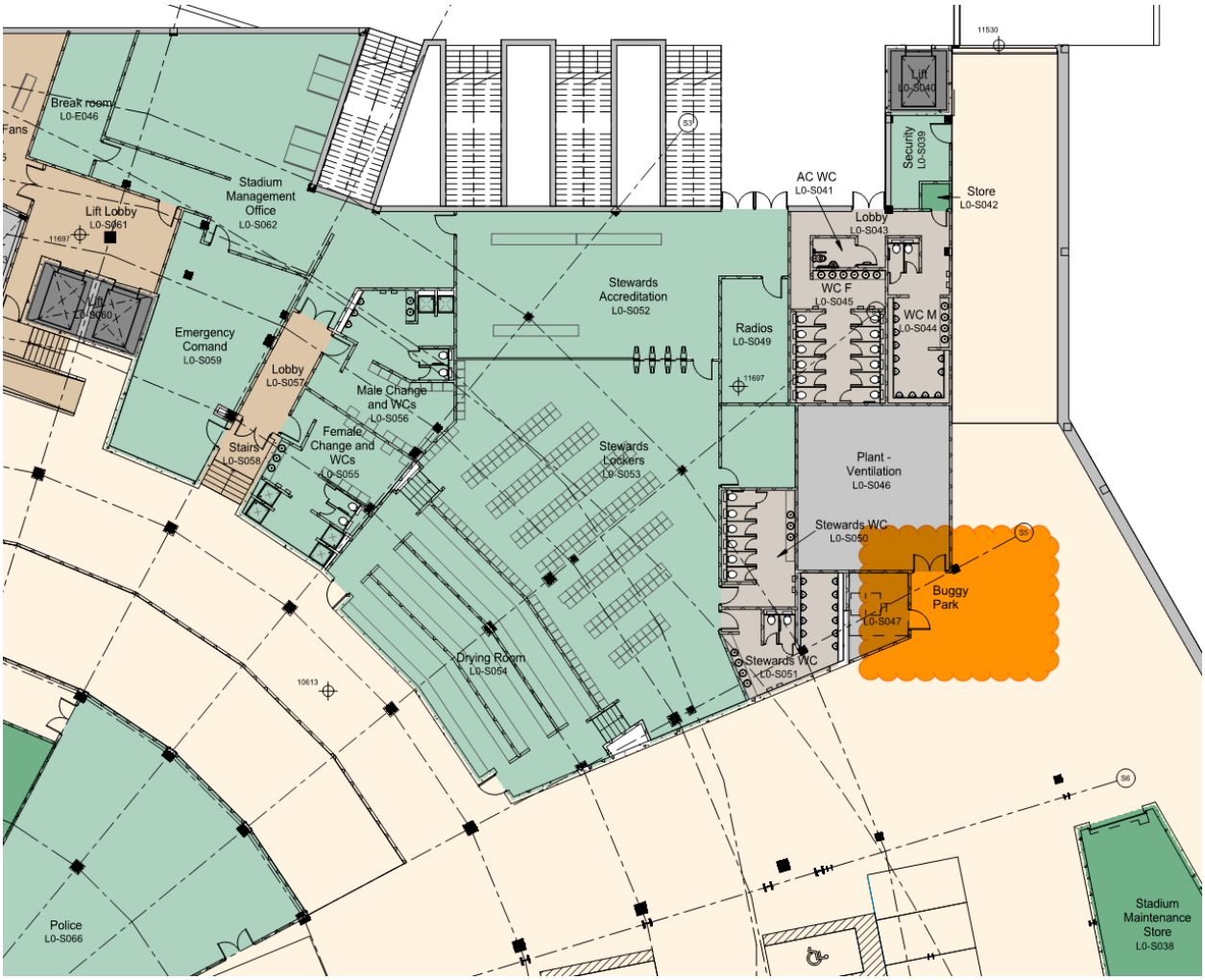
Figure 9: Designated buggy parks



A stadium maintenance and grounds keeping store is present at the north-east of the stadium, adjacent to the waste and recycling area. This store has capacity for the storage of grass waste for up to fifteen 240 litre bins. The use of easily manoeuvrable small bins that grounds-keeping staff can place cuttings directly into on the pitch side is recommended. The bins will then be transferred to the waste and recycling area approximately three times a week on the day of collection to prevent them becoming odorous. The bins will be cleaned in the waste and recycling area and returned to the grounds keeping store.

3.6.5 General Fans Concourse Areas (Levels 1 to 5)

Intermediate waste storage is allocated within all of the general concourse areas throughout the building on each level of the stadium that is generating waste to ensure waste management operations are discreet. The storage rooms are adequately sized to ensure they can each house 2 x 660 litre bins and 1 x 240 litre bin. Each level of the stadium is self-sufficient for the period of time before, during and after games. Waste collected from the food outlets and litter collected from the concourse will be taken to these rooms.

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Each of the food outlets will have space for the temporary storage of waste allocated within them including as a minimum 1 x 240 litre bin for food waste. Waste from the food outlets will be transferred at regular and convenient intervals during and following the game by catering staff to the nearest intermediate waste room for bulking and collection by the FM team.

All of the drinks served within the general concourses will be served in plastic bottles or cups. This will eliminate glass as a waste stream within the general concourses. The mixed recyclables collected within these areas should only comprises plastic bottles and cups, cardboard food packaging and small amounts of paper which is likely to include programmes, leaflets and newspapers.

Within the food court in the South Stand larger intermediate waste rooms have been allocated to reflect the amount of waste that is likely to be generated in this area. This will allow waste to be stored locally as the food court will be congested before and after the match and during the half time interval.

Two-stream litter bins for residual waste and mixed recyclables will be located throughout the concourses, with the acceptance that uptake will be poor and waste will need to be sorted in a MRF . THFC appreciate that typically fans are notoriously bad at recycling and compliance rates are low and significant contamination occurring, particularly from liquids and it is often difficult for fans to locate the bins due to the crowds and to be able to access the bins to dispose of waste. Despite this, THFC consider not having bins as an unhygienic approach and are currently considering the most appropriate bins to use within the concourses and exploring options to encourage and facilitate recycling by fans. Possible options include the use of screens to indicate the location of the nearest bins, taller bins for improved visibility within the concourses, sloped bins to prevent fans crowding round the bins and using them as tables and colour-coded packaging and bags to make it easy to distinguish which bin should be used to dispose of particular items.

Waste will be collected by hand during the first half and second halves and again after the final whistle by the FM team. A large number of relatively narrow shelves will be present throughout the entire concourse areas which will encourage fans to leave their empty cups and packaging on these shelves. It is hoped that this approach will prevent fans disposing of half-drunk liquids within the mixed recyclables bins and causing contamination of cardboard packaging and preventing it from being recycled or compromising its quality. FM staff will empty any containers containing liquid on the shelves into a separate container, with the liquid then poured down the sink within the food outlets. Recyclable packaging (cardboard, plastic cups and food containers) can then be collected via a positive pick.

Waste from the intermediate waste rooms will be collected by the FM team along with litter collected from the concourses and transferred to the waste and recycling room using the stadium lifts. The service lifts will be used as a preference, with the remainder of the waste moved by the general admission lifts, outlined in **Appendix D**.

Away Fans

The away fans areas are situated in a segregated area. located on Levels 1 and 2 and capacity will vary between 1,000 and 9,150 fans per game depending on the type of the game and the opposition being played. It is estimated, based on the waste calculations undertaken that up to five tonnes of waste will be produced in these areas per game (based on a 0.546kg generation rate per fan). Adjustable barriers will be installed to ensure the segregation of home and away fans before, during and after games. The away fans areas will be self-sufficient and operate in isolation in terms of waste on match days.

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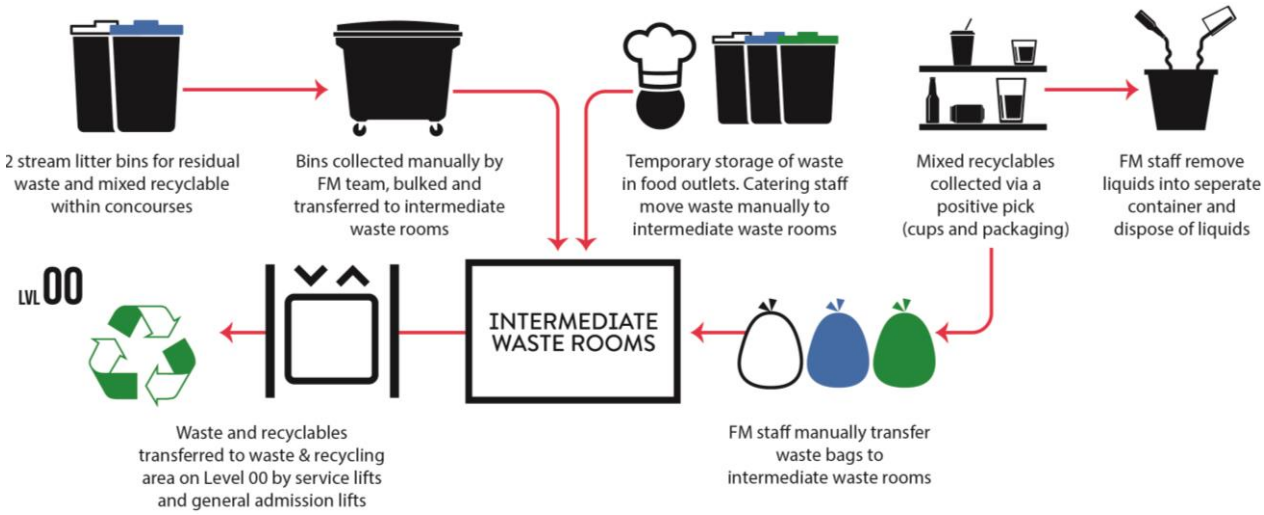
The waste collection strategy within the away fans areas will be the same as the general concourses although all waste generated will have to be stored temporarily in intermediate waste rooms until all fans have departed the stadium. Intermediate waste rooms have been allocated within the centre of the away fans areas to ensure that even if the barriers are adjusted then the intermediate waste room will still be located within the areas. The rooms have been designed for full away fans capacity.

Figure 10: Waste Management within the General Concourses


2 stream litter bins for residual waste and mixed recyclable within concourses
Bins collected manually by FM team, bulked and transferred to intermediate waste rooms
Temporary storage of waste in food outlets. Catering staff move waste manually to intermediate waste rooms
Mixed recyclables collected via a positive pick (cups and packaging)
FM staff remove liquids into seperate container and dispose of liquids
LVL 00
INTERMEDIATE WASTE ROOMS
Waste and recyclables transferred to waste & recycling area on Level 00 by service lifts and general admission lifts
FM staff manually transfer waste bags to intermediate waste rooms

Concourse Areas at Risk

BuroHappold undertook a further study based upon detailed occupancy numbers provided by Populous (27.07.15). The purpose of this study was to use this data which outlined the maximum occupancy (or waste case) in the various areas of the stadium to test the robustness of the posed strategy. This outlined the worst case scenario for an average game where the greatest pressure is exerted on the waste management infrastructure, the results of this are provided in Appendix F.

In summary only two areas of risk where identified, these where the South Stand at Level 02 and Level 04. Primary issue has arisen due to lack of intermediate storage areas provided, the consequence of which is that the waste generated within the South stand on Level 02 cannot be held within the stand for the entirety of the match. This means that the area will likely become heavily littered and in need of frequent servicing during game play (i.e. after kick off and half time, in addition to when fans have left). A major challenge is the fact that the South stand is located between corporate areas East and West, as such waste cannot be moved to service lifts without moving them through these areas which may detract from fan experience.

Two options to overcome this have been identified within the Design Note (see Appendix F) and Populous have further outlined the team post planning will be looking to provide an additional service lift in the southern cores which can be used during match play to service these areas. As such a suitable solution will be incorporated into the design.

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3.6.6 Hospitality Areas (Levels 2 to 4, 6, 7 and 9)

Intermediate waste storage is allocated within the hospitality and corporate areas within the stadium. The storage rooms are sized to ensure they can each house a minimum of 2 x 660 litre bins and 1 x 240 litre bin. Storage space for waste has also been provided locally within the kitchens and bar areas to ensure waste management within these areas is discreet, this is essential within these high-class areas of the stadium. All kitchens will also contain food de-waterers into which food scraps collected from cleared tables will be inputted. Off-cuts from kitchen preparation will also go into the dewaterers however the amount is expected to be minimal as the majority of preparation is to occur rin the production kitchen at Level 00.

All of the hospitality lounges and bars as well as each of the corporate boxes will contain three-stream litter bins to encourage the collection and segregation of waste. These areas will be much less crowded than the general concourses so correct waste segregation is more likely to occur.

A large proportion of the segregation that will be carried out within the hospitality areas will be undertaken by the catering staff. In the restaurant areas, tables will be cleared with waste managed within the kitchens. 2 x 660 litre bins and a 1 x 240 litre bin will be provided in all kitchens, with full bins taken to the closest intermediate waste room at a convenient time by the catering staff. 1 x 240 litre bin for glass collected will be provided as appropriate. The FM team will then exchange the full bins within the intermediate waste rooms with empty bins brought up from the waste and recycling area. Within the bars, waste will be sorted as it is collected from tables and lounges within the hospitality areas. Glass will be separated into designated bins where appropriate. It is essential that catering staff are provided with adequate training to ensure that they are aware of the procedure for separating waste, mixed recyclables and food waste as well as glass.

The service lifts and the general admission lifts do not have access to the Sky Lounge on Sky Bridge on Level 9 within the stadium. All of the waste generated on this level will therefore have to be removed via the hospitality lifts in the eastern and western stands to Level 5 and then transferred into the service lifts once all fans have departed. Consequently, all waste generated before, during and after the game will need to be moved from the Sky Bridge and Sky Lounge and bulked on this level within intermediate waste rooms located at the western and eastern ends of the stadium. These rooms have been sized to enable them to accommodate waste for the required timeframes, any excess will be accommodated within the bins provided by the bars.

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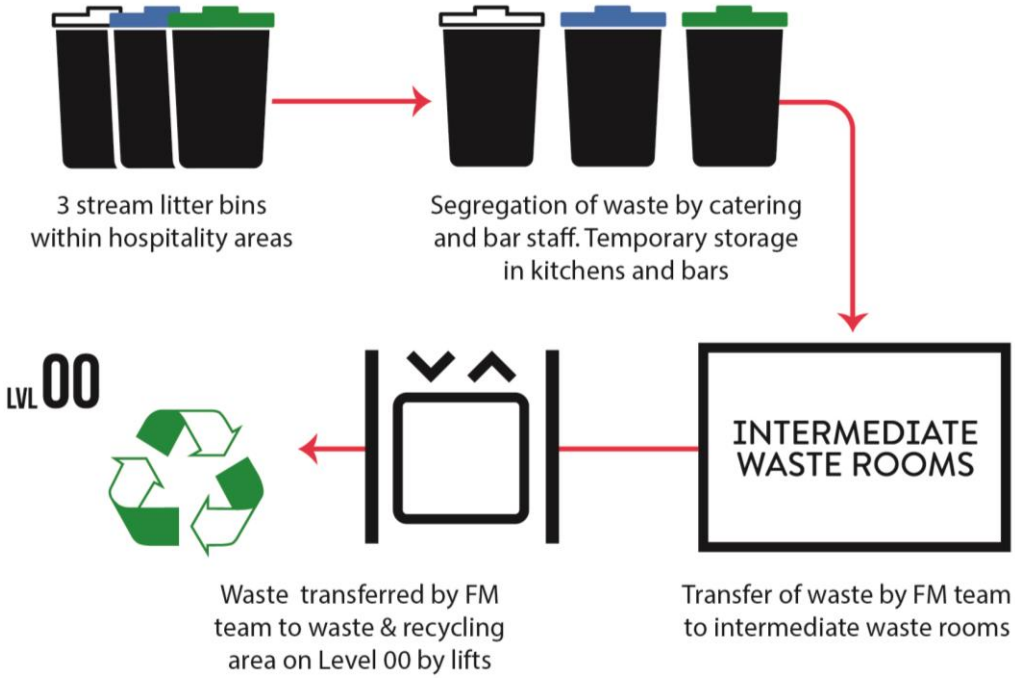
Figure 11: Waste Management within the Hospitality Areas


3 stream litter bins within hospitality areas
Segregation of waste by catering and bar staff. Temporary storage in kitchens and bars
INTERMEDIATE WASTE ROOMS
LVL 00
Waste transferred by FM team to waste & recycling area on Level 00 by lifts
Transfer of waste by FM team to intermediate waste rooms

3.6.7 THFC Offices (Level 6 and 7)

The THFC offices are present on Level 6 and Level 7. Waste will be segregated at source by office staff in three-stream bins for mixed recyclables (glass, plastic, paper and cardboard), organic waste and residual waste provided on each floor. The offices will be serviced by the FM team, who will collect the waste from the offices on a daily basis and be taken to Level 00 via the service lift in the west stand before being transferred to the waste and recycling area.

Figure 12: Example of Bins for use in Offices

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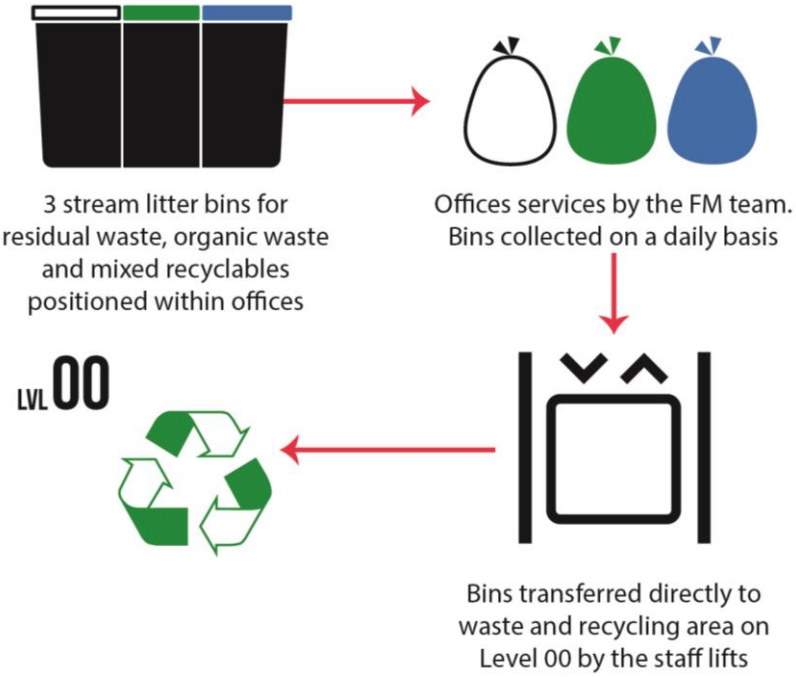
Figure 13: Waste Management within the THFC offices


3 stream litter bins for residual waste, organic waste and mixed recyclables positioned within offices
Offices services by the FM team. Bins collected on a daily basis
LVL 00
Bins transferred directly to waste and recycling area on Level 00 by the staff lifts

3.6.8 THFC Experience

The waste generated within the THFC will consist mainly of packaging based materials resulting from goods delivered to the retail and merchandising units. As detailed in **Section 4.5.1** a large amount of product will be de-bulked off-site to reduce the amount of packaging generated within the THFC Experience. Small amounts of waste will also be produced by staff and customers.

Waste from the THFC experience will be removed via the car park at the south-west of the stadium on Level 00 and transferred to the waste and recycling area through the east stand to avoid waste being removed from the front of the building through the public realm. This will ensure operations are discreet.

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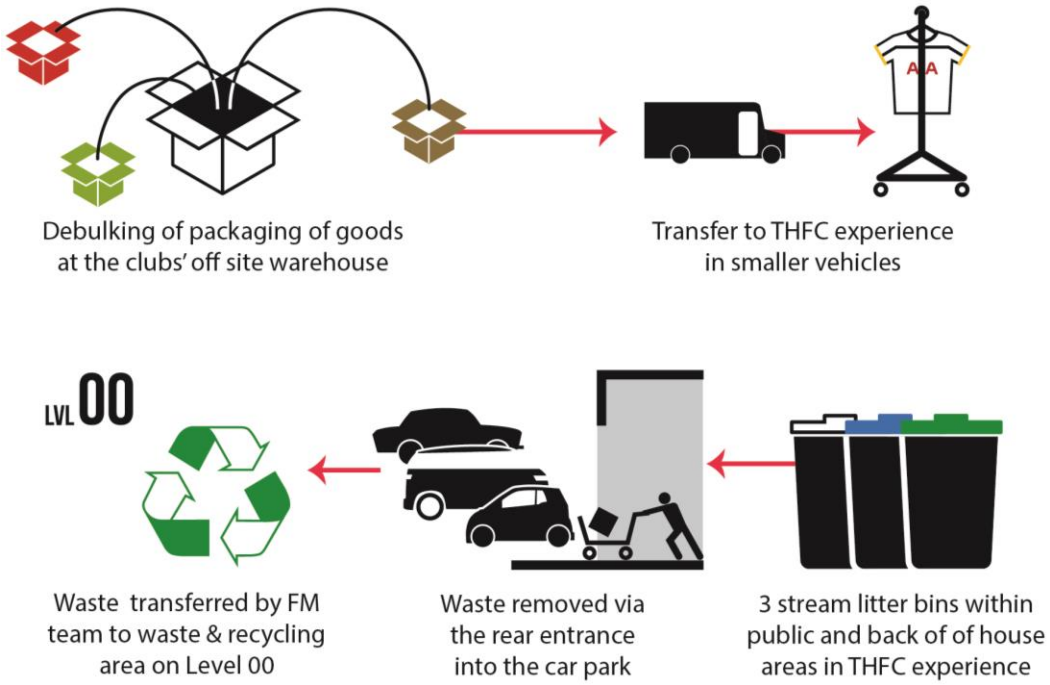
Figure 14: Waste Management within the THFC Experience


Debulking of packaging of goods at the clubs' off site warehouse
Transfer to THFC experience in smaller vehicles
LVL 00
Waste transferred by FM team to waste & recycling area on Level 00
Waste removed via the rear entrance into the car park
3 stream litter bins within public and back of of house areas in THFC experience

3.6.9 Public Square and Stadium Podium

For the purpose of the waste calculations, outlined in **Section 3** it has been assumed that there will be approximately ten three stream litter bins located within the public square which, on average will be serviced once a day. On match days it is likely that the bins will need to be emptied more frequently and a litter pick will also have to be undertaken by FM staff. The FM team will collect the litter bins, with the bagged waste bulked in larger 660 and 240 litre bins. The bins will be collected using an EV which will take all waste either to the lift on the podium at the north-east of the stadium which has direct access to the waste and recycling area or entrance at the south of the stadium which has lift access to Level 00. From here waste will be taken to the waste and recycling area for processing. There are security issues associated with the inclusion of bins within the public realm. The stadium and surrounding area will be very crowded on match day and there will be an increased security risk. Bins that are considered to limit the security risk should be considered.

There are various options which include:

- Plastic hoops with a clear plastic bag (limited expense);
- Letter box litter bins built into the structure which remove waste from the public realm, however means a back of house area is required and the implication of incorporating this into the design; or
- Blast resistant bins which can withstand a minimum of 0.5kg of explosives (expensive).

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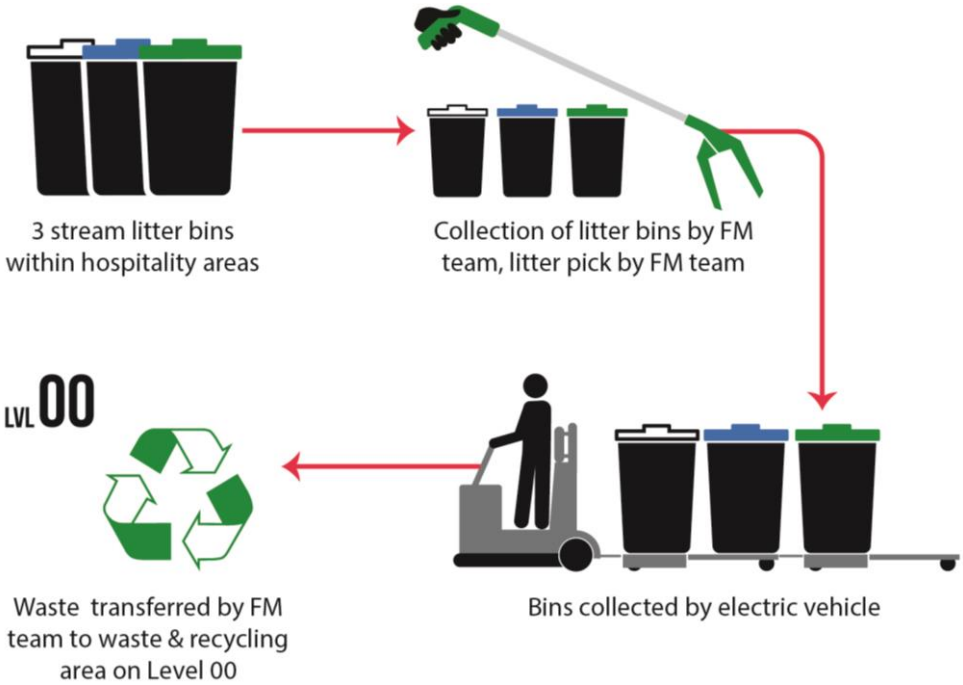
Figure 15: Examples of bins for use within the public square and on the stadium podium

Figure 16: Waste Management within the Public Square and Stadium Podium


3 stream litter bins within hospitality areas
Collection of litter bins by FM team, litter pick by FM team
LVL 00
Waste transferred by FM team to waste & recycling area on Level 00
Bins collected by electric vehicle

3.6.10 Football Pitch

The THFC pitch will be retractable and will be mown approximately three times per week outside of the winter months. Grounds-keeping staff will transport the designated 1100 litre bins to the pitch side so that as the grass is cut, it can be immediately emptied into the bins. The bins will be temporarily stored within the grounds-keeping storage area at the north-east of the stadium until they are due to be collected from the waste and recycling area by a waste contractor. The bins will be transported to the waste and recycling area on the morning on which they are due to be collected and will be temporarily stored within the waste and recycling area. Once collected, the empty bins will be transported back to the grounds-keeping store.

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Figure 17: Football Pitch Waste Management

Groundskeeping staff mow pitch grass approximately 3 times a week
Grass waste is collected in designated 1100 litre bins pitch side
LVL 00
Bins transferred to waste and recycling area for collection at regular intervals
Bins transferred to groundskeeping store

3.6.11 University Technical College

All waste from the UTC will be managed by THFC. The FM teams from the UTC will collect waste within the building and transfer it to the waste and recycling area, where it will then become the responsibility of THFC from both a duty of care and a financial respect. No designated storage space within the waste and recycling area will be provided for waste generated from the UTC.

3.6.12 North-east Building

Goods delivery and waste collection to the north-east building is to be managed via their own small goods and waste area within the building's independent core and removed via Worcester Avenue.

3.6.13 NFL Games and Concerts

The current approach is for stage equipment, props, goal post and other equipment required for these events to be brought onto the field of play by arctic lorries. All specialist wastes, such as props etc. will be removed following the event. THFC will deal with all other waste generated by these events.

Consideration has been given to a worse-case scenario in terms of waste generation within the stadium. This would be a football match and an NFL game or other sporting within one weekend. This would need to be managed by increased collection, with pick-ups between the games and increased FM team staffing levels. There is sufficient spatial capacity within the waste and recycling area.

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3.7 Logistics and Other Issues

3.7.1 Incoming Goods

In order to develop an effective waste servicing strategy and ensure the building can operate in an efficient and sustainable manner, it is imperative to understand goods servicing and access throughout the stadium. Large amounts of goods will be entering the stadium via the service yard and loading dock for transportation around the building. Goods will be unloaded, brought into the stadium and distributed to the appropriate locations throughout the stadium using EVs. No dedicated goods area is located within the vicinity of the service yard and loading dock. Therefore, goods including food and drink, products associated with the retail, office, media and player facilities, FM and cleaning operations and hospitality will be distributed directly upon arrival (i.e. no temporary holding) to where they are needed within the stadium and then removed from their packaging. Packaging will be bulked locally before being brought to the waste and recycling area, ideally in the now empty goods cages. THFC will encourage the delivery of goods in bulk to minimise the number of vehicle trips to the stadium, particularly on match days, immediately before and after matches.

Incoming goods for the THFC Experience will be imported to the stadium in smaller vehicles from Worcester Avenue. Current proposals indicate that goods will be brought onto Level 00 and brought into the THFC experience via the rear entrance directly into the goods and waste storage area. Most of the items to be sold within the store will be de-packaged at the Club's off-site warehouse so that the amount of packaging waste generated is minimised.

Where possible efforts will be made to minimise the amount of packaging brought to the stadium with as much of the packaging returned to the supplier for re-use or recycling as detailed in **Appendix C**.

Goods delivery to the north-east building is to be managed via their own small goods and waste area which will be constructed within the service yard.

3.7.2 Security

Access from the highway will be through a security barrier system and only recognised vehicles will be allowed to enter the service yard. In addition, access to each of the waste bays will be controlled by a motorised roller shutter which will be access controlled.

There will be restricted access to the waste and recycling area and additional access restrictions to the clinical and hazardous waste storage area (likely to be in the form of a locked cabinet or caged area) to ensure building user safety. It is anticipated this will be via a swipe card or key code system. All clinical waste will be tagged, double bagged and containerised in lockable cages or boxes.

All waste management operations, including the collection and emptying of compactors and removal of baled recyclables will be overseen by the FM team and stadium security. There will be a security office within the service yard next to the waste and recycling area from which goods delivery and waste collection for the stadium, UTC and THFC experience will be managed.

3.7.3 Education

THFC will aim to educate fans about where bins are located and provide clear signage with recycling and disposal guidance. The key is to try and change fans behavioural patterns when it comes to waste as they will be used to not participating in recycling initiatives, as there is minimal recycling within the existing THFC stadium. A number of initiatives to encourage fans to recycle within the stadium will be explored by THFC, these initiatives are listed in **Appendix C** and include the use of leaflets, loudspeaker announcements and the football programmes.

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3.7.4 Duty of Care

A Waste Transfer Note (WTN) is required for each load (i.e. container, bin or bag of waste, compactor or other receptacle) of waste that leaves the THFC site. Copies of these WTNs need to be kept for a minimum of two years as they are written proof that the waste producer is handling their waste correctly and in line with legal requirements. It is possible to obtain a season ticket if the type of waste is consistent. With regards to the UTC, THFC will need to agree to manage their waste and take responsibility for this waste from both a duty of care and a financial respect.

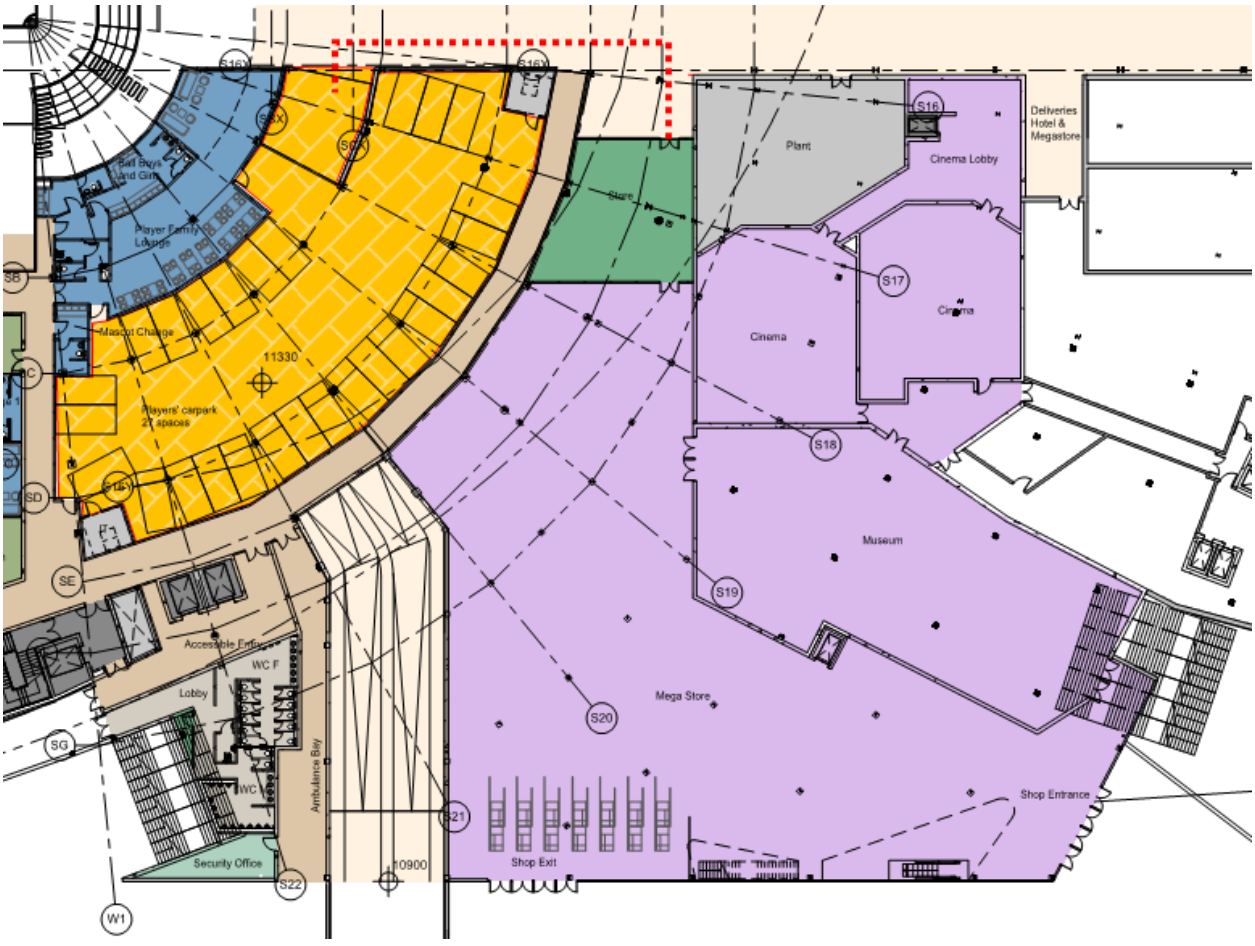
3.7.5 Retractable Pitch Out

Occasionally the retractable football pitch will be out of position and will occupy the majority of the car parking area on Level 00. This will limit access to the THFC hotel and THFC experience back of house areas.

3.7.6 Hotel Waste Management

When the pitch is retracted internal arrangements in tehs tadiumw ill not eb affected, waste generated within the THFC Experience however will not be able to be transported across the car park. As such waste from the THFC Experience will be stored in the players car park immediately adjacent the development as detailed in **Figure 18**. This car park will not be in use when the pitch is extended and is sufficiently sized to hold a minimum of 3 days waste generation from THFC Experience and the hotel.

Figure 18: THFC temporary waste storage solution



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4 Waste and Recycling Area

4.1 Storage and Processing

The waste and recycling area occupies an area of approximately 337m² at the north-east of the stadium on Level 00 with an additional 57m² of external space for service and waste loading. As detailed in **Section 4** and **Section 5**, all waste generated throughout the stadium and from the THFC experience, public square and UTC will be brought to this area for temporary storage, processing, bulking and subsequent removal off-site.

All waste management operations will be overseen by the FM team and stadium security. There will be a security office within the service yard next to the waste and recycling area from which waste collection will be managed.

The waste and recycling area has been designed to include space for the following storage areas and equipment:

- A temporary bin storage area for commingled recycling (mixed plastics, glass, paper and cardboard with a small volume of metal cans also anticipated), residual waste and organic (food). In additional space for the storage of glass bins from hospitality areas should be allocated. It is anticipated that once bins have been emptied and washed they will be returned to the intermediate waste rooms throughout the stadium as quickly as possible;
- A dedicated secure cabinet or caged area for the storage of clinical, medical and any hazardous wastes. All clinical waste will be tagged, double bagged and containerised in lockable cages or boxes;
- Locked confidential waste bins likely to be up to 5 x 240 litre bins. THFC may prefer to shred their own confidential waste within their offices and dispose of the shredded paper within the mixed recycling bins;
- Bulky wastes will be stored within the furniture store in the basement so no space for bulky waste is required;
- A portable residual waste compactor (approximately 30m³ capable of holding up to 8 tonnes of waste) with an attached bin lift. The typical dimensions of the compactor would be 2.51m in height, 2.4m wide and 6.1m in length;
- Space for the storage of a small quantity of WEEE wastes that will be generated and a battery bin;
- A bin wash area with appropriate drainage provision;
- Some spare capacity to allow for flexibility in the event of the worse-case scenario in terms of waste generation which would be a football match and an NFL game or other sporting event within one weekend;
- Space for the storage of the temporary, wheeled three-stream honesty bins that will be used at all fan entrances on match days. These will be folded away when not in use;
- The 1100 litre bins containing grass waste will be brought into the waste and recycling area on collection days (anticipated to be three times a week) so spare capacity for the temporary storage of these bins will be required. It is hoped that this waste, along with the food waste collected within the stadium can be taken to an Anaerobic Digestion (AD) plant;
- As a minimum, three balers, one for cardboard and paper, one for green and one for clear plastics will need to be provided. The balers could be provided as part of an elevated mini-MRF system which THFC are currently considering as an effective solution to the waste management challenges within the stadium;

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Figure 19: Examples of balers for use within the Waste and Recycling Area

- An elevated mini-MRF conveyor belt system which would comprise an elevated platform on which the operatives picking the waste could stand and conveyor belt with space for 1100 litres bins and / or a plastic and cardboard baler beneath it is being considered by THFC. The MRF would contain vertical drop shoots from the elevated platform to the bins or balers beneath the direct vertical drop chutes to prevent spilling of recyclables. The MRF would be fitted with a bin lifter to enable wastes to be tipped directly onto the conveyer belt. While the upfront costs of the MRF would be high this system would facilitate quick, high quality effective recycling within the stadium, increase waste clearance times within the stadium bowl, concourse areas and throughout the stadium and reduce the number of compactors that would be required within the stadium and the number of collections required. In addition, there is the potential for the re-sale of recyclables to generate income; and
- THFC are also considering the inclusion of a glass crusher, which would reduce the volume of the waste being removed from the stadium with the potential for the re-sale of crushed glass to generate some income. The option of a food dewatering system is also being explored, this would significantly reduce the weight of the food waste produced.

Figure 20 below outlines the proposed layout of the waste and recycling area.

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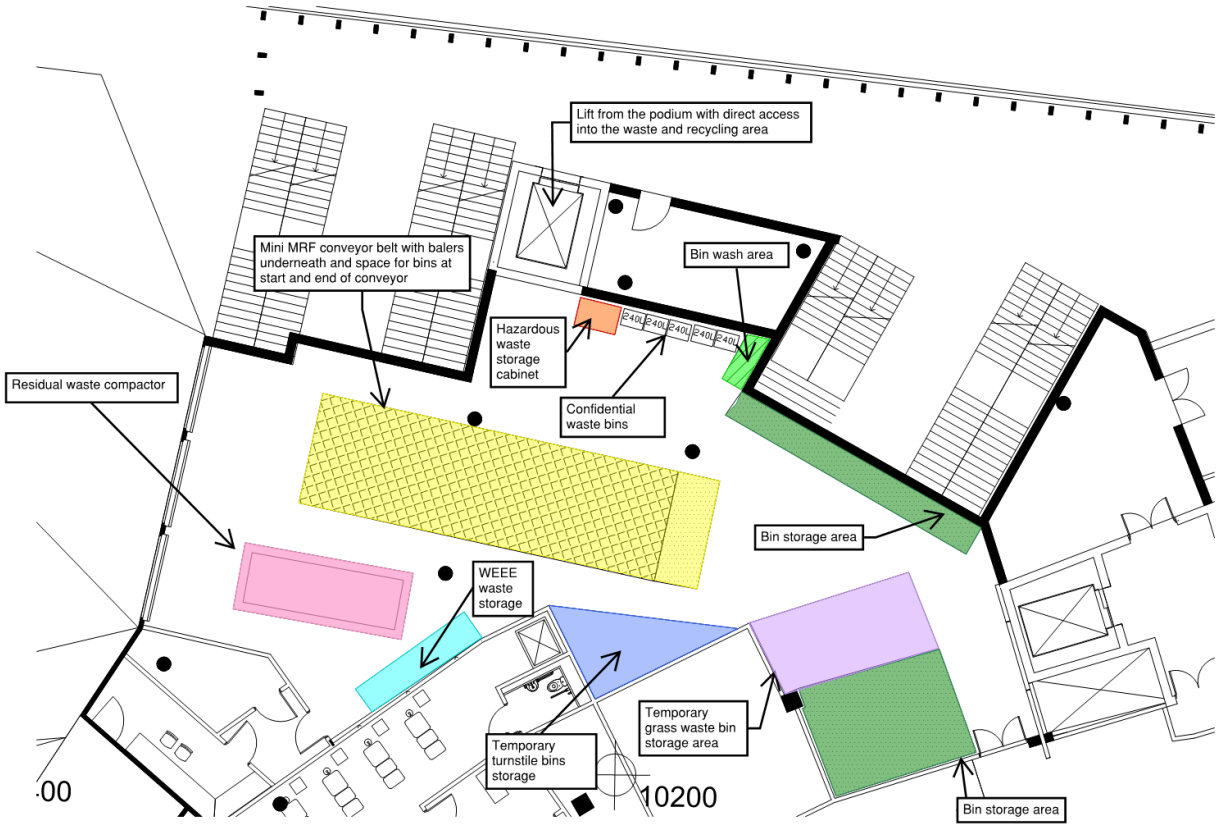
Figure 20: Waste and recycling area layout


Lift from the podium with direct access into the waste and recycling area
Mini MRF conveyor belt with balers underneath and space for bins at start and end of conveyor
Bin wash area
Hazardous waste storage cabinet
Residual waste compactor
Confidential waste bins
Bin storage area
WEEE waste storage
Temporary grass waste bin storage area
Temporary turnstile bins storage
10200
Bin storage area

4.2 Waste Collection

Waste will be collected from the northern end of the waste and recycling area in the loading area within the service yard. Each waste stream will be collected on a specific day or at set times depending on the match and event schedule. Baled materials will be lifted using a mini-forklift and taken into the service area. Bins containing glass, organic (food) waste and grass waste will be pulled out into the service yard when the collection vehicle arrives. The residual waste compactor will be lifted out of the service yard and onto the back of the collection vehicle and replaced with an empty compactor.

Analysis of the waste collection operations with the service yard has been undertaken to ensure they do not interfere with goods delivery and other activities taking place, particularly on, immediately before or after a match day.

The tracking detailed in **Figure 21** demonstrates that the collection vehicles will enter via the Sainsbury's service yard, manoeuvre appropriately and collect the compactor and waste as appropriate. A minimum head room of 5.5m has been accommodated to enable the compactor lift.

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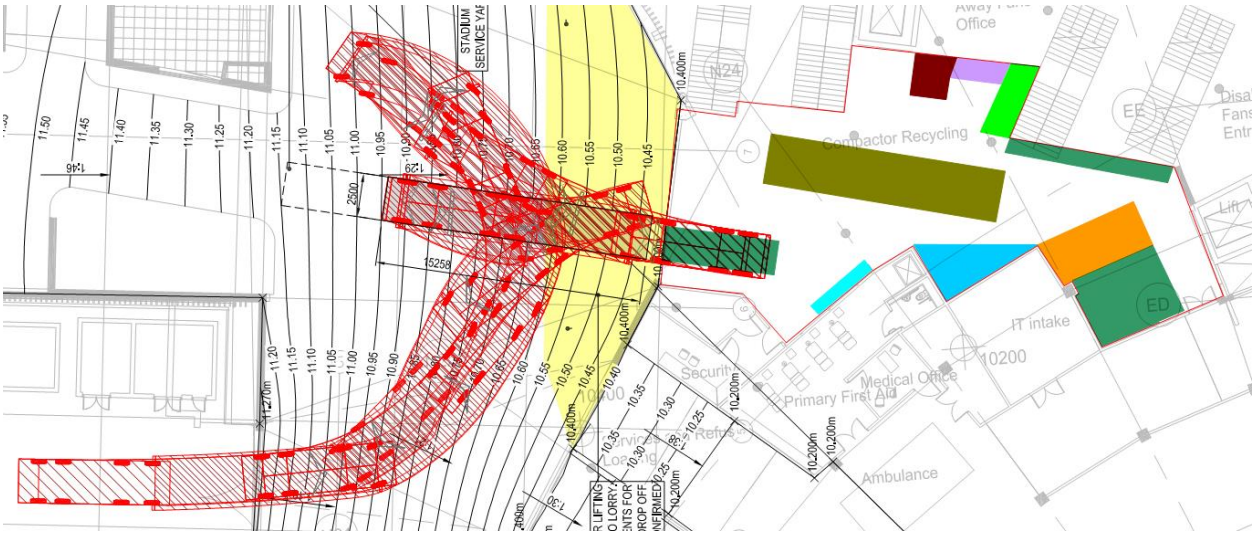
Figure 21: Refuse collection tracking



All waste collection vehicles will need to report to security and be supervised by a banksman at THFC when collecting waste. WTNs will need to be provided for all collections and kept for a minimum of two years.

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5 Conclusions

- Productive and efficient waste management practice is required at the stadium, THFC experience, UTC and public square to ensure waste is managed in a way that maximises venue turnaround times and ensures waste management operations are discreet. The client hopes that the development will be a leading example of excellent waste management within both the sporting and education sector, which achieves a recycling rate of at least 50%, with the aim of improving recycling rates and reducing waste generation each year following opening;
- Outline waste generation calculations estimate that approximately 1,446 tonnes of waste will be produced within the stadium, THFC experience, UTC and public square per year;
- All waste will be collected and transferred to the waste and recycling area at the north-east of the stadium on Level 00 for bulking and removal; and
- Waste will be segregated at source, where practicable into the following three main streams: residual waste, mixed recyclables (glass, paper, cardboard, plastics) and organic waste (food and landscaping waste including grass waste from the pitch). In addition, a number of other waste streams including clinical and hazardous wastes, confidential waste, bulky waste including old furniture and WEEE wastes.

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Appendix A – Waste Management Practice and Policy

Information on the relevant national and local waste management practice and policy is provided below. There is a large amount of national policy and guidance however little LBH guidance for commercial waste is available. Existing guidance provides comprehensive and detailed storage and collection requirements for new developments within the borough although the focus is on residential developments. However, the guidance provides direction to ensure good practice and effective and efficient waste management.

National

Government Review of Waste Policy 2011

Prioritises efforts to manage waste in line with the waste hierarchy and reduce the carbon effect of waste. This document also encourages waste prevention and re-use, supporting greater efficiency and initiatives which reward and recognises individuals who reduce, re-use and recycle their waste. It also sets out plans to work with councils to increase the frequency and quality of rubbish collections and make it easier to recycle.

Hazardous Waste (England and Wales) (Amendment) Regulations 2009 SI 507

The Hazardous Waste Regulations, which came into force in 2005 provide requirements for controlling and tracking the movement of hazardous waste and bans mixing different types of hazardous waste.

The Waste Strategy for England 2007 (WS2007)

The Department of Environment Food and Rural Affairs (DEFRA) in 2009 updated the published WS2007. There is a focus primarily on Municipal Solid Waste (MSW), as well as making provision for the future creation of recycling / recovery targets for Commercial & Industrial (C&I) waste.

The Waste (England and Wales) (Amended) Regulations 2012

These regulations came into force 29 March 2011. The regulations implement the revised Waste Framework Directive and require businesses to confirm that they have applied the waste management hierarchy when transferring waste. They introduce a two-tier system for waste carrier and broker registration along with a new concept of waste dealer. They also exclude some categories of waste from waste controls and include a small number of radioactive materials.

Making Space for Waste, A Practical Guide for Developers and Local Authorities, June 2010

This document was designed to allow developers to follow a step by step process when considering the design of waste facilities in new developments.

Material Recovery Facility (MRF) Code of Practice for England and Wales:

The regulations require all permitted MRFs processing more than 1,000 tonnes of dry recyclables per annum to measure and report the quality of the input, output and residual waste streams every three months. This is intended to boost confidence in the quality of material produced at MRFs.

The Producer Responsibility Obligations (Packaging Waste) (Amendment) Regulations 2012

Aims to achieve requirements of the EU Directive 94/62/EC (as amended) by setting packaging recycling targets on larger UK business.

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Local

The London Plan 2013 (Sustainable Design and Construction Supplementary Planning Guidance April 2014)

Describes an integrated economic, social environmental and transport framework for the development of London over the next 20 to 25 years. The plan sets out to improve the environment and tackle climate change by reducing CO_2 emissions and improving London's recycling performance and waste management. The plan provides updated guidance on designing out waste in buildings during the early stages of a project and on the importance of sufficient and well-designed storage for recyclables, organic and residual waste and the implementation of the waste hierarchy.

The Mayor's Municipal Waste Management Strategy 2011

This document sets out the Mayor's policies and proposals for reducing the amount of municipal waste produced, increasing the amount of waste re-used, recycled or composted, and generating low carbon energy from waste remaining. This strategy also sets out how the Mayor, through the London Waste and Recycling Board, will help develop waste management infrastructure in London. Broadly, the key targets are for zero waste to landfill, a reduction in household waste generation rates of 20%, increased recycling rates to 60% and the generation of energy from waste where appropriate. The Mayor's targets are for London as a whole, placing no specific requirements on individual waste authorities to achieve them.

The Mayor's Business Waste Management Strategy 2011

Sets out initiatives to help London's business (from shops, restaurants, office buildings, manufacturers to construction companies) to save money and reduce harm to the environment through better waste management. Of specific relevance here are the Mayor's proposals to ensure buildings provide suitable storage and access for the management of waste. Additionally, the Mayor will be supporting planning guidance to engage developers, architects and designers in looking for ways to design out waste at source and improve the overall resource efficiency of buildings and infrastructure projects.

London Borough of Haringey (LBH)

Information related to the current waste management practices and policies in LBH has been extracted from the following documents and is summarised below:

- London Borough of Haringey Local Plan;
- London Borough of Haringey Sustainable Design and Construction Supplementary Planning Document (adopted May 2013); and
- North London Joint Waste Strategy.

LBH has strategies in place which seek to deliver more sustainable waste management, namely encouraging waste reduction, maximising re-use and recycling and treating remaining waste as a resource in line with the waste hierarchy.

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LBH currently collects mixed recyclables (paper, cardboard, plastic, glass, cans), organics (food and garden waste) and residual waste. Bulky waste collection is also provided. For businesses, commercial collection services of residual waste and dry recycling can be provided. Local planning guidance states that consideration should be given to how the storage and collection of waste and recyclable material can best be incorporated. Commercial waste collection is dependent on waste type and storage capacity. All waste storage areas, internal and external, must be easily accessible to both collectors and occupants. Enough space should be provided on-site to securely and safely store all waste and recycling containers. Space should be provided inside buildings to allow the separation of waste into containers for recyclables, organics and residual waste.

The LBH require all major planning applications within LBH to provide a Site Waste Management Plan (SWMP) with any planning submission. The content of the plan must include full details of the arrangements for the storage and collection of waste for disposal and waste to be recycled. The plan must make reference to the following:

- The number, type and size of receptacles to be dedicated to storage of residual waste and recyclables;
- The positions where receptacles are to be stored between collections;
- The size, design and materials used in construction of any housing built for the storage of receptacles;
- Access arrangements for persons using receptacles showing that consideration has been given to safety, equalities, convenience, user friendliness and maximum walking distances under building regulations; and
- Access arrangements for collection personnel giving consideration to Health and Safety at Work Act, recommended maximum pulling distances for receptacles, vehicle access, height and turning requirements and the construction and width of pathways, doors and access ways.

LBH is working with the North London Boroughs of Hackney, Enfield, Waltham Forest, Barnet, Camden and Islington as part of the North London Waste Plan (NLWP) to achieve 45% recycling and composting standards by 2015 and 50% by 2020 in line with national policy. LBH aim to meet the targets set in the NLWP in a sustainable manner by:

- Promoting the prevention and reduction of waste produced in the borough, increasing the re-use of materials wherever possible, and seeking to increase recycling and composting of waste;
- Ensuring that new development including change of use provides accessible, adequate and well-designed internal and external storage facilities and recycling infrastructure for both residual and recyclable wastes;
- Ensuring that waste is minimised during the design and construction of new developments, encourage the use of sustainably sourced materials and requiring developments to make on-site provision for the recycling and re-use of construction, demolition and operational wastes;
- Ensuring there is sufficient land allocated for waste management purposes and establishing appropriate policies for waste applications to maximise self-sufficiency through the Joint NLWP and applying its policies to waste development. Additionally the council will safeguard existing waste management sites within LBWF; and
- Encouraging waste to be treated as close to the source as possible and encouraging sustainable movement of waste, maximising the potential use of rail and water transport where waste is not treated at its source.

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Tottenham Hotspur Football Club Waste Management

Aims and Aspirations

There is no BREEAM target for the scheme. However, meetings with the client, design team and THFC staff and contractors involved in cleaning and waste management were held (1st October and 6th November 2014 and 12th February 2015) to discuss the preliminary waste management aims and aspirations for the development. The client recognises that in order for the venue to operate in a productive and efficient manner good waste management is required. The client wants to ensure safe operational practice and efficiency within the development. The following aims, aspirations and general principles have been agreed with THFC:

- Develop productive and efficient waste management practice to ensure the new THFC stadium and associated facilities are a leading example of excellent waste management within the sporting sector;
- Keep back of house areas and public realm areas segregated in terms of waste as far as possible to ensure waste management operations are discreet;
- Ensure waste is managed in a way that maximises venue turnaround times;
- Achieve a recycling rate of at least 50% with zero waste to landfill;
- Assess opportunities for packaging reductions, re-use or recovery, but in a manner that does not negate need to reduce waste volumes. Where possible packaging should be returned to the supplier for re-use;
- Aim to reduce the existing waste generation rate per fan by at least 25%. The aim is to reduce the waste generation rate which is currently 0.546kg per fan per game to 0.4095 kg per fan per game;
- Employ a private waste management contractor capable of weighing all waste collected from the stadium to ensure that records of the tonnages of the individual waste streams are maintained; and
- Undertake an annual waste audit to track the quantities of residual waste, organics and recyclables that are produced. This will enable THFC to monitor their performance against their targets.

THFC Policy and Guidance Documents

THFC is committed to manage its waste in line with the waste hierarchy, as shown in **Figure 1**, and other relevant national and local legislation and guidance. THFC have produced the following waste management policy and guidance documents to ensure that all waste generated within the stadium is disposed of safely and efficiently to ensure good waste management.

These documents will be updated as the design for the new THFC stadium and associated facilities progresses. A brief summary of the key objectives and principles outlined in each of these documents is provided below.

THFC Waste Management Policy (dated January 2015)

- As a minimum, the collection of the following key waste streams should take place: residual waste, mixed recyclables (glass, paper and cardboard and plastics) and organics (food and landscaping waste);
- Provision for other specialist wastes including hazardous wastes (i.e. paints, chemicals, pesticides, medical / clinical wastes), confidential waste, bulk wastes and Waste Electrical and Electronic Equipment (WEEE) should be made;

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- Provide designated waste receptacles throughout the stadium to encourage waste segregation at source as far as practicable (i.e. in offices, hospitality and food oulets, kitchens, general concourse areas, player and media facilities and the THFC experience). All waste receptacles must be clearly marked;
- Minimise waste production and increase re-use and recycling in line with the waste hierarchy;
- Waste will be collected at regular intervals and where possible, waste will be processed on site prior to collection (i.e. compacting and baling of recyclables) to reduce the volume of waste generated;
- Establish ambitious waste and recycling targets (these have not yet been finalised by THFC) and undertake a waste audit on an annual basis;
- Raise awareness of waste management issues by offering waste management training to all staff; and
- It will be the overall responsibility of the Operations Director to ensure that waste is managed successfully throughout the stadium.

THFC Employer's Requirements (dated August 2014)

- Waste receptacles are to be located adjacent to catering units at lower concourse level only (Level 1) and be sufficient size to contain two 1100 litre wheeled bins;
- Waste is to be cleared immediately after half time and at full time to waste rooms and held temporarily at the main concourse levels (Levels 1 and 5) and transported to the waste and recycling area by lift;
- A minimum of $15m_2$ of waste store space on each general admission level should be allocated. Bagged waste may be stored on the floors and wash down facilities are required. Provision for charging of electric vehicles (EVs) may be required;
- Waste produced in food outlets within the general concourse and hospitality areas will be stored until after the event. It will then be removed to the waste area by lift. All rubbish will be segregated prior to being removed; and
- The requirements for a compactor area will be a minimum of $180m_2$. This must accommodate at least two compactors and skips (for residual are recyclable wastes) with an associated wash down area. A minimum of 5.5m of headroom should be allocated.

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Appendix B - Emirates Stadium Precedent Study Findings

A precedent study on the nature and characteristics of the waste management operations taking place at the Emirates Football Stadium (the home of Arsenal Football Club) has been undertaken by BuroHappold. The Emirates Stadium was selected as it is a Premier League Football Stadium within the London area with a similar capacity to that of the new THFC stadium. The aim of this study was to try and identify the key issues that the FM teams working within this venue are facing and how this is affecting the efficiency of waste management operations on a day to day basis. Visits to Arsenal's Emirates Stadium were undertaken on 29th October 2014 and 12th January 2015 with the Deputy Stadium Manager, Michael Lloyd. The findings of the visits are summarised below:

Summary of Main Issues

- No dedicated service lifts for goods and waste and there is a lack of space for bins and bale storage on the ground floor within the dedicated waste area;
- No intermediate storage in food and beverage units and no of intermediate storage on each floor;
- Time cost to separate waste by hand, this is a very labour intensive process but has proved to be the most effective way of improving recycling rates at the stadium;
- Cost of waste removal (per tonne and transport costs) and capital expensive of waste equipment and technology;
- Getting contractors and fans to 'buy-in' and adopt the waste initiatives and improve recycling rates. It is hard to change the habits of fans;
- Getting to 'buy-in' and support from senior management on waste issues due to budget limitations. However, for the current season (2014/2015) money has now been allocated to support sustainability issues with energy reduction being the main focus; and
- Finding suitable recycling technology and options including hot and cold cups, food packaging, wanting different colour plastic separated etc. has proved problematic.

Key Observations

- The following main waste streams are segregated: residual waste, recyclables (paper, cardboard, plastic, metal, glass), grass, bulky wastes, hazardous waste and other streams including wood and electrical items;
- The stadium recycled 78% of its waste during the 2012 / 2013 football season;
- All waste, goods, general admission, disabled and corporate fans use the same lifts to move vertically around the stadium. This causes a number of issues on match days;
- It takes the FM team approximately 4 hours following a game to sort the waste into recyclables and non-recyclables once all waste has been transferred to the ground floor. Current waste management operations are heavily reliant on the FM team and are not very efficient with high staff costs;
- There is insufficient space for the storage of waste receptacles within the kitchen areas and insufficient intermediate storage is allocated on each level of the stadium. The spaces allocated are not enclosed and are located within the public realm adjacent to lifts and stairwells;

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- Bins are located throughout corporate and general admission areas and waste is segregated at source although all waste is then mixed as it passes down the waste chute and is sorted by hand within the waste and recycling area;
- The waste chute often blocks with staff putting unsuitable materials into the system;
- Food waste is not segregated and is removed with residual waste. Grass is currently removed as residual waste;
- Plastic and cardboard are baled at the site using a large baler and sold (approximately 10 tonnes a month);
- Glass bottles and beer on tap used in both general admission and hospitality areas;
- Large areas of the ground floor are occupied by rows of bins and waste facilities. Large areas of the car park under the podium have been consumed by waste management operations;
- Use of hand driers instead of paper towels; and
- Use of compostable packaging was explored but this was considered to be too expensive for use.

Mini-Material Recovery Facility (MRF)

There is consideration towards the use of a mini-Material Recovery style facility (MRF). The aim of this is to gain full value for the recyclable waste content as waste is not currently separated well by fans in the general concourse, stands and hospitality areas so a MRF should make that quicker and easier. Currently the stadium's waste contractor extracts all the recyclables sells them independently. The stadium is keen to recover some of this cost for itself. It is hoped that the use of a MRF will allow better control of the waste and allow more options to recycle. It is hoped that this will also reduce costs as less waste will be removed from the site.

Arsenal trialled a mini-MRF system, provided by Portable Conveyers Ltd. for January to early February 2015. The system comprised a conveyer belt operated by five FM staff, one placing all the bagged waste onto the conveyer belt and moving bins once full, one opening the bags and three picking out the different types of waste from the conveyer belt. Typically following each game, it took one and a half days for all of the waste to be processed through the mini-MRF. Typically four tonnes of recyclables were recovered per game and re-sale costs were approximately £250 per half tonne bale for clear plastic and £30-£40 per half tonne bale for cardboard and disposable cups.

Typical waste and recycling figures following the use of the mini-MRF were as follows:

- 1 x pallet of clear plastic bottles and 1 x pallet of green plastic bottles;
- 1 x pallet of disposal cups;
- 33 x 240 litre bins of glass bottles;
- 1 x 240 litre bin of aluminium cans; and
- 3 tonnes of food waste and approximately 2.5 to 3 tonnes of general waste.

The reduction in general waste produced per game meant that the general waste compactor at the stadium had to be emptied 50% less than normal, resulting in waste management contractor fees for collection being reduced. A detailed assessment of the waste data and comparative study is yet to be undertaken.

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The likely cost of the mini-MRF are likely to be in the region of £22,000 plus the cost of addition FM staff to operate the system. However, Arsenal are exploring this option as they think it will be economically viable as the amount of waste collected and requiring disposal will be reduced and there is the potential for considerable income from the re-sale of collected recyclables.

In addition, Arsenal are also aiming to send all grass waste to an Anaerobic Digestion (AD) facility for energy from waste processing from early 2015.

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Appendix C Initiatives to Reduce Waste

It is recommended that the following initiatives are considered by THFC to reduce the amount of waste and improve recycling and re-use within the stadium and associated facilities. If these initiatives are adopted, it is essential that spatial provision is allocated:

Type	Option
Sustainable Catering Alternatives	
Reduce	Promote the serving of beer on tap to reduce the plastic and glass produced
Reduce	Do not serve drinks in tins and aluminium cans to eliminate metal as a waste stream
Reduce	Use of glasses to serve drinks instead of disposable cups, particularly in hospitality areas
Reduce	Minimise packaging of products and encourage the backhauling and re-use of packaging
Reduce	Consider the use of compostable packaging for crisps, chocolate, drinks and other snacks
Reduce	Use an inventory system to provide control over supplies to avoid over-ordering and waste
Reduce	Use of part-prepared food (i.e. peeled vegetables, de-boned meat etc.) and freezing of food
Reduce	Review of portion sizes to ensure only as much food as is needed is prepared and cooked
Reduce	Use of cutlery, china and glass as oppose to disposable crockery and cutlery
Reduce	Inform staff that they are to hand out straws, lids, and napkins only when requested
Reduce	All condiments should be dispensed from bulk containers rather than single-serve packets
Reduce	Consider purchasing beverage mixes in concentrated form
Reduce	Use of individually dispensed, unwrapped plastic utensils, biodegradable utensils, or none at all
Recycle	Use of locally sourced food and drink and donate surplus food to local food banks (if edible)
Recycle	Streamline drinks sales, ideally to the complete use of plastic bottles as oppose to glass
Recycle	Streamline food packaging, ideally to the same material (cardboard or plastic) to make it easier to achieve high quality recycled materials
Other Alternatives	
Reduce	Utilising washable cloth towels instead of paper towels to clean up behind the counters
Reduce	Use of hand dryers instead of paper towels
Reduce	Minimise paper-based marketing and circulate by email and buying recycled content supplies
Recycle	Bins at ticket turnstiles to encourage disposal prior to entering i.e. cans, half eaten food etc.
Recycle	Sell or give old equipment and furniture to local businesses, charity or educational projects
Recycle	Recycling printer cartridges
Recycle	Interactive signage presenting information showing where waste and recyclables collected from the stadium go and what happens after collection. Recycling figures could also be presented
Recycle	Details on how fans can recycle could be provided to all season ticket holders in their welcome pack
Recycle	Signs on the turnstiles, back of toilet doors, within the concourses and food outlets could promote recycling. In addition, recycling information could be displayed on all match day tickets and within the club programme or over the loudspeakers
Recycle	An education programme with local schools and local councils to raise awareness, particularly the younger generation about the importance of recycling and how this works within the stadium could be undertaken
Recycle	Colour coding packaging labels to the appropriate bins i.e. black label on item bought indicates residual waste to be placed in the black bin and green label on packaging to be placed in green bin etc.
Recycle	A recycling mascot for the club targeting children who are the fans of the future
Use of Technology	
Reduce	Consider the use of a dewatering system to reduce the volume of food waste

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Type	Option
Recycle	A glass crusher could be purchased. This would require clear and coloured glass to be separated and then crushed outside of operating hours to avoid noise disturbing games and other events
Recycle	Consideration to the use of a plastic shredder to reduce the volume of waste storage (storing bottles takes up a large amount of space due to the volume of air contained within each bottle) could be given
Recycle	Flatten and bale cardboard generated from packaging to reduce bulk using a baler
Recycle	Bale plastic generated from general concourse areas using a baler
Recycle	Install a mini-Materials Recovery Facility (MRF) on site to improve the quantity and quality of recyclables

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Appendix D – Use of Lifts for the Movement of Waste

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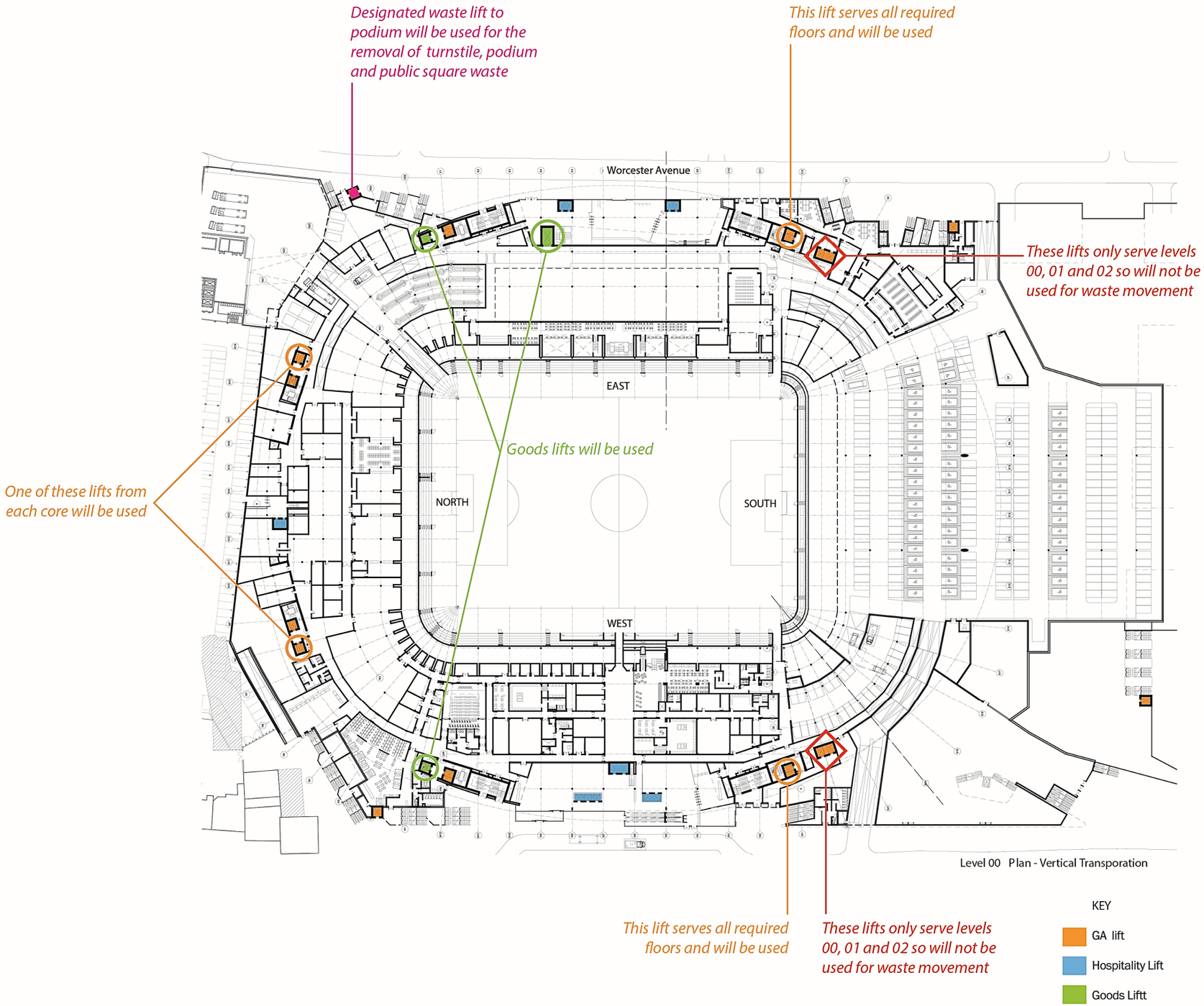
Designated waste lift to podium will be used for the removal of turnstile, podium and public square waste
This lift serves all required floors and will be used
These lifts only serve levels 00, 01 and 02 so will not be used for waste movement
Goods lifts will be used
One of these lifts from each core will be used
Worcester Avenue
EAST
NORTH
SOUTH
WEST
This lift serves all required floors and will be used
These lifts only serve levels 00, 01 and 02 so will not be used for waste movement
KEY
GA lift
Hospitality Lift
Goods Liftt

Level 00 Plan - Vertical Transporation

Appendix E Waste Flow Route Analysis

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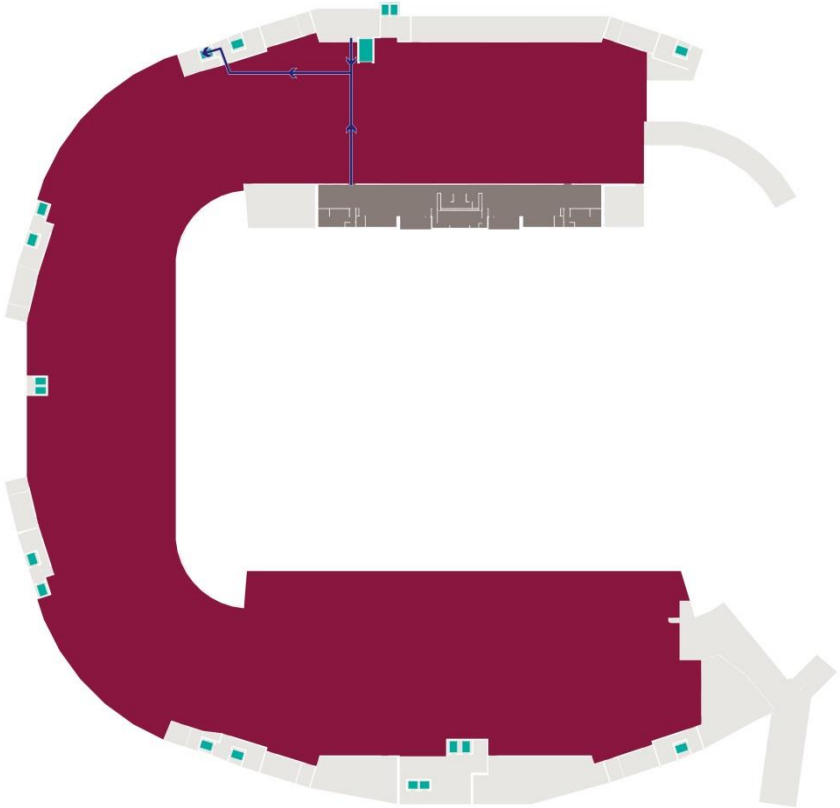

LEVEL B1

TOTTENHAM HOTSPUR FOOTBALL CLUB NEW STADIUM

OCTOBER 2014

WASTE MANAGEMENT KEY

Waste collection areas

- Service yard, waste management facilities and bins
- Kitchen and bar areas
- Hospitality and boxes
- Lifts
- Player, media and office facilities
- Tottenham Experience (café, museum and retail)
- Car parking
- Stadium bowl general admission seating

Waste collection routes

- Highest quantity of waste
- Lowest quantity of waste

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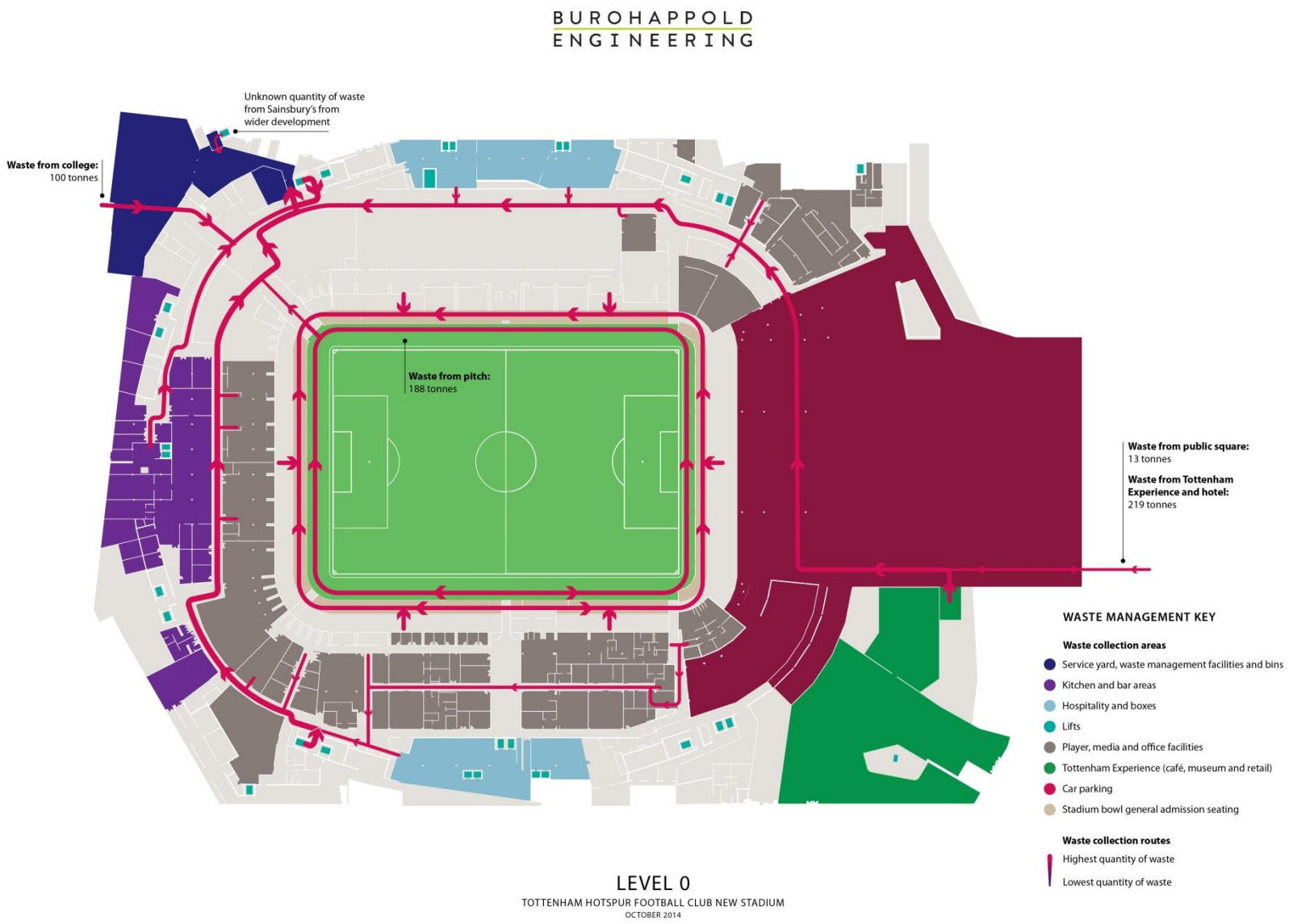
BUROHAPPOLD ENGINEERING
Unknown quantity of waste from Sainsbury's from wider development
Waste from college: 100 tonnes
Waste from pitch: 188 tonnes
Waste from public square: 13 tonnes
Waste from Tottenham Experience and hotel: 219 tonnes
WASTE MANAGEMENT KEY
Waste collection areas
Service yard, waste management facilities and bins
Kitchen and bar areas
Hospitality and boxes
Lifts
Player, media and office facilities
Tottenham Experience (café, museum and retail)
Car parking
Stadium bowl general admission seating
Waste collection routes
Highest quantity of waste
Lowest quantity of waste
LEVEL 0
TOTTENHAM HOTSPUR FOOTBALL CLUB NEW STADIUM
OCTOBER 2014

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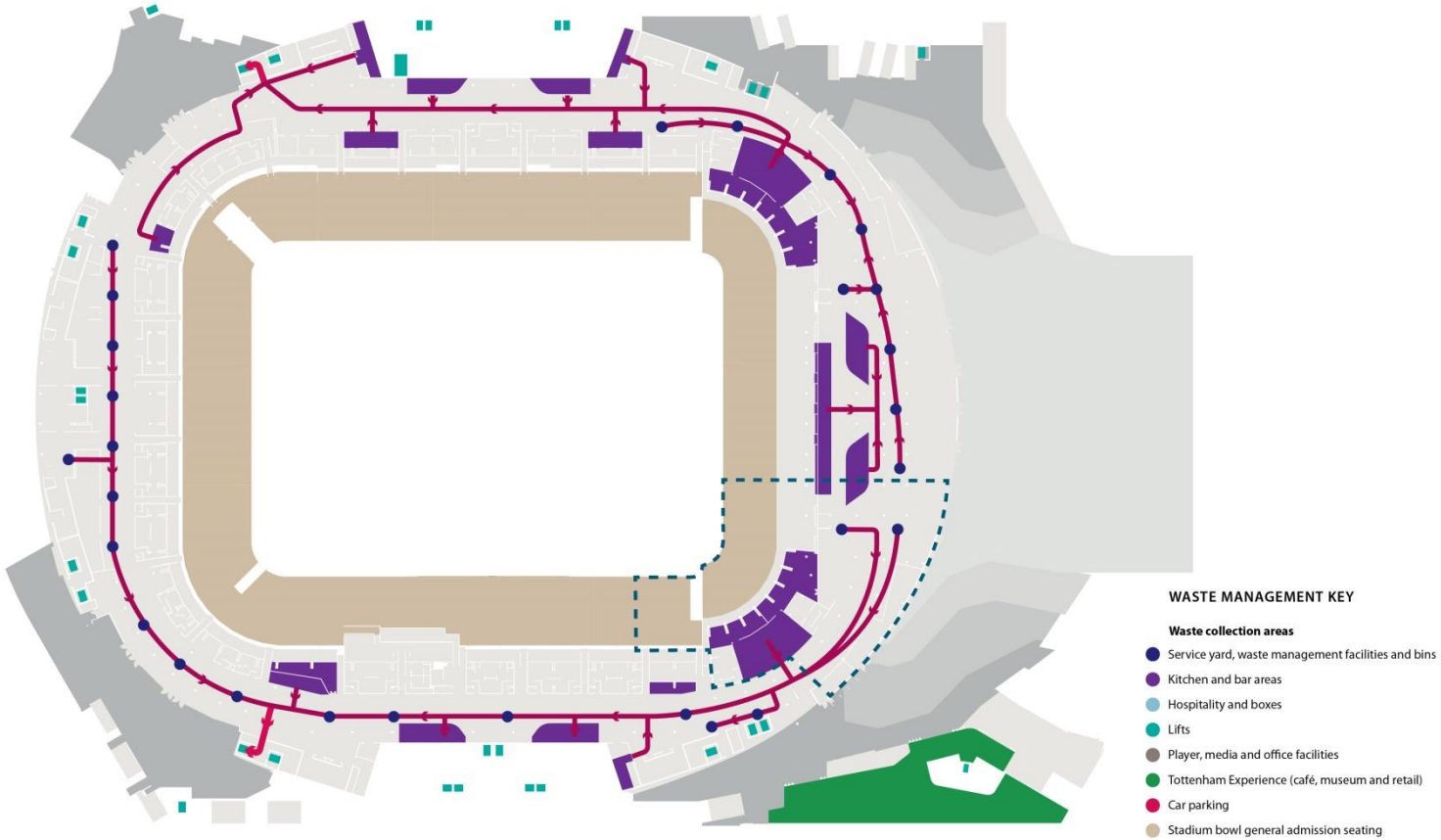

LEVEL 1
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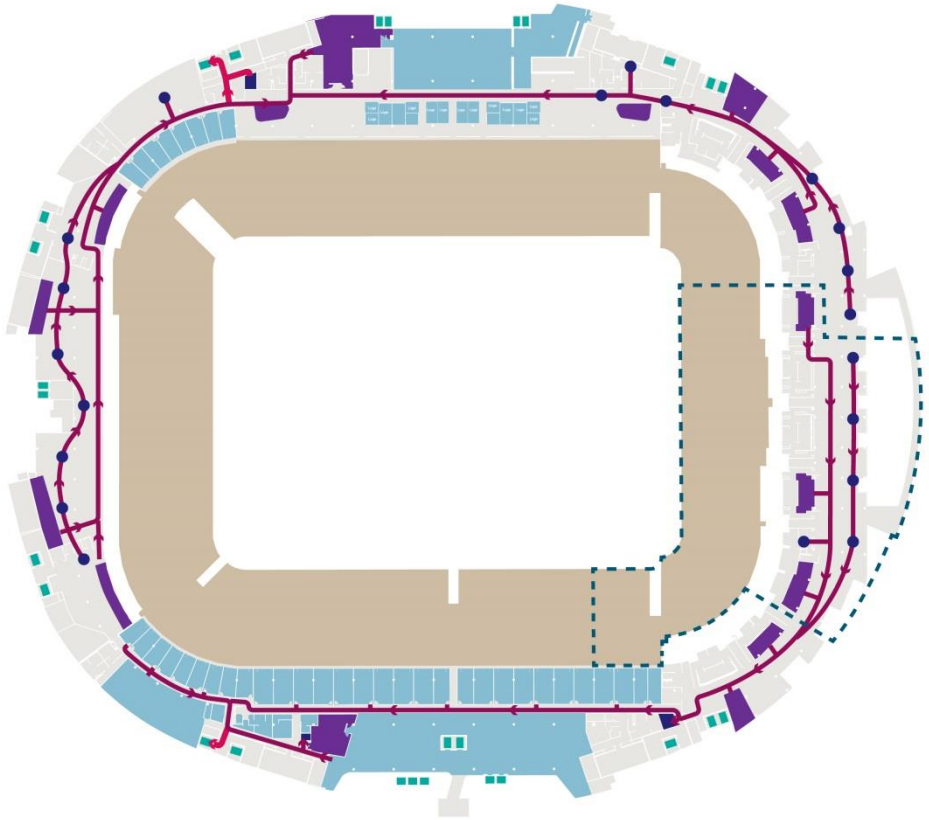

WASTE MANAGEMENT KEY

Waste collection areas

- Service yard, waste management facilities and bins
- Kitchen and bar areas
- Hospitality and boxes
- Lifts
- Player, media and office facilities
- Tottenham Experience (café, museum and retail)
- Car parking
- Stadium bowl general admission seating

Waste collection routes

- Highest quantity of waste
- Lowest quantity of waste

LEVEL 2

TOTTENHAM HOTSPUR FOOTBALL CLUB NEW STADIUM

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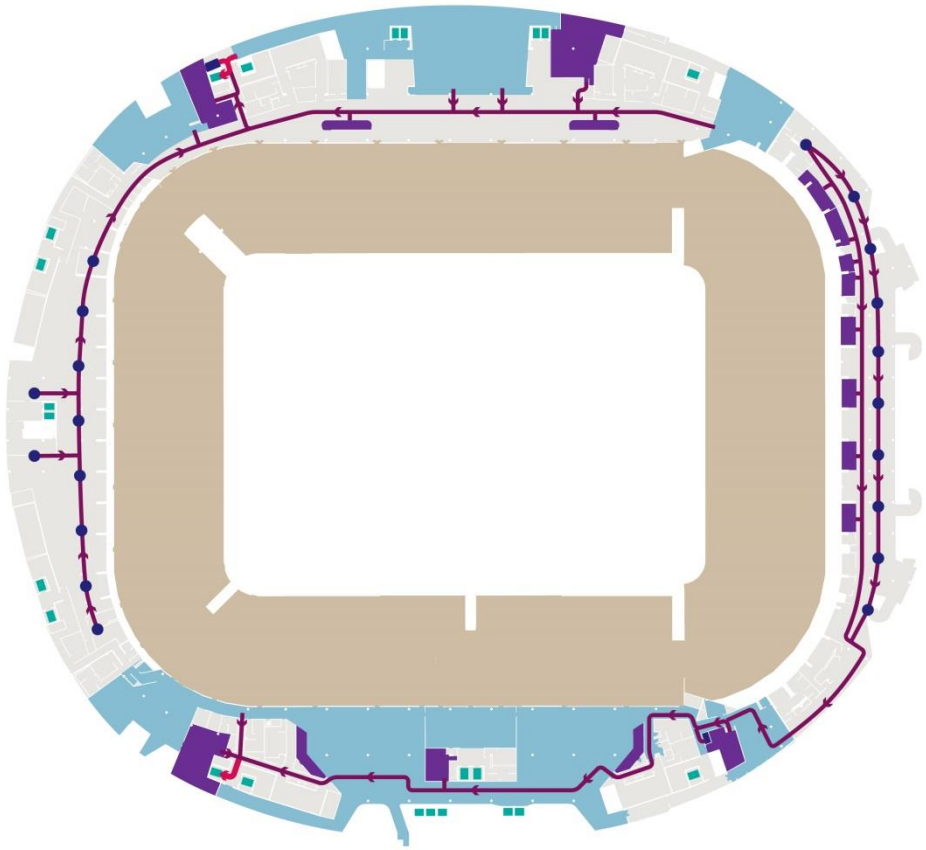

WASTE MANAGEMENT KEY

Waste collection areas

- Service yard, waste management facilities and bins
- Kitchen and bar areas
- Hospitality and boxes
- Lifts
- Player, media and office facilities
- Tottenham Experience (café, museum and retail)
- Car parking
- Stadium bowl general admission seating

Waste collection routes

- Highest quantity of waste
- Lowest quantity of waste

LEVEL 3

TOTTENHAM HOTSPUR FOOTBALL CLUB NEW STADIUM

OCTOBER 2014

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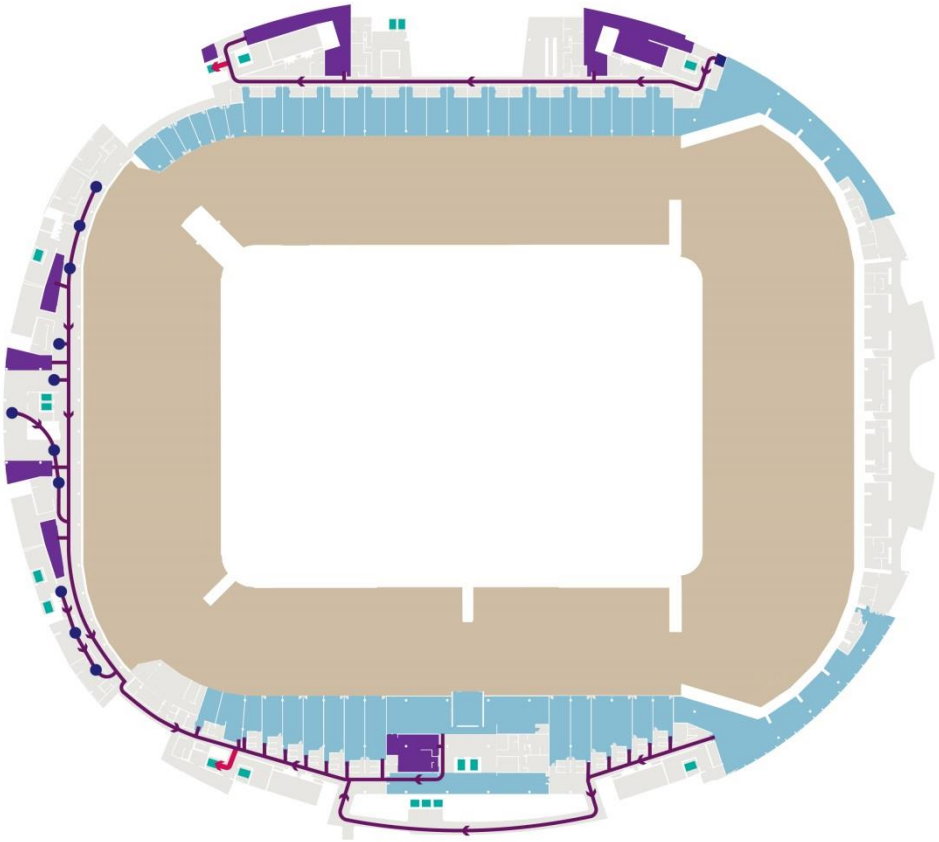

WASTE MANAGEMENT KEY

Waste collection areas

- Service yard, waste management facilities and bins
- Kitchen and bar areas
- Hospitality and boxes
- Lifts
- Player, media and office facilities
- Tottenham Experience (café, museum and retail)
- Car parking
- Stadium bowl general admission seating

Waste collection routes

- Highest quantity of waste
- Lowest quantity of waste

LEVEL 4

TOTTENHAM HOTSPUR FOOTBALL CLUB NEW STADIUM

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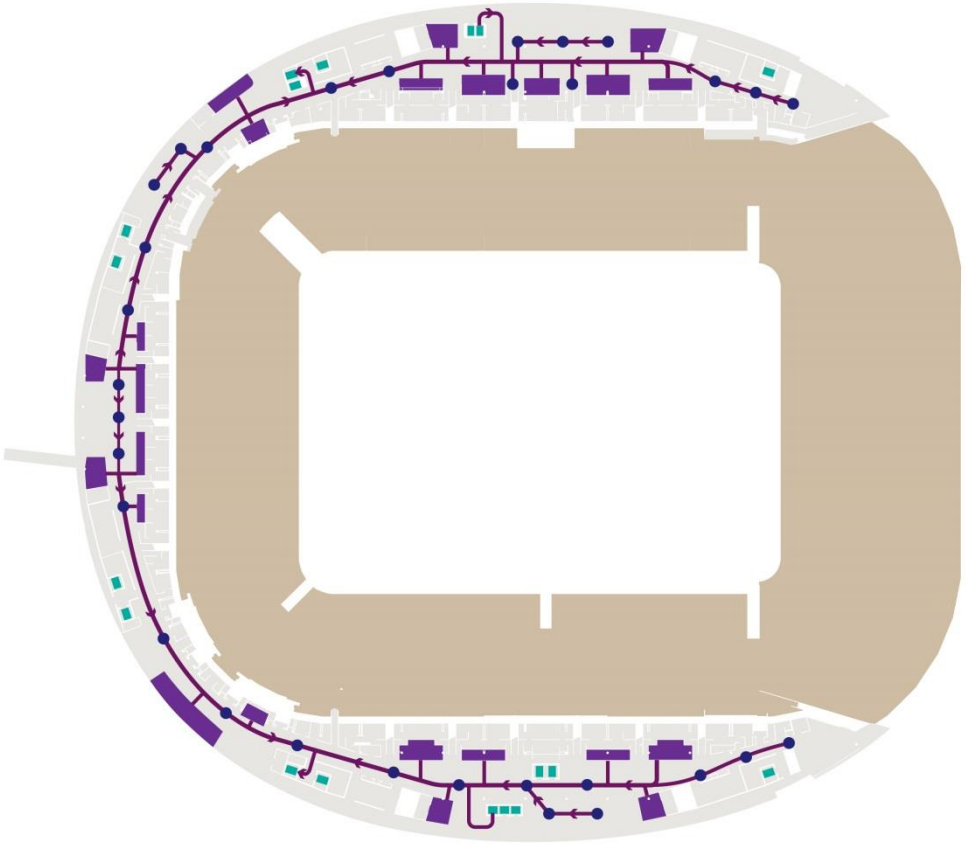

LEVEL 5

TOTTENHAM HOTSPUR FOOTBALL CLUB NEW STADIUM

OCTOBER 2014

WASTE MANAGEMENT KEY

Waste collection areas

- Service yard, waste management facilities and bins
- Kitchen and bar areas
- Hospitality and boxes
- Lifts
- Player, media and office facilities
- Tottenham Experience (café, museum and retail)
- Car parking
- Stadium bowl general admission seating

Waste collection routes

- Highest quantity of waste
- Lowest quantity of waste

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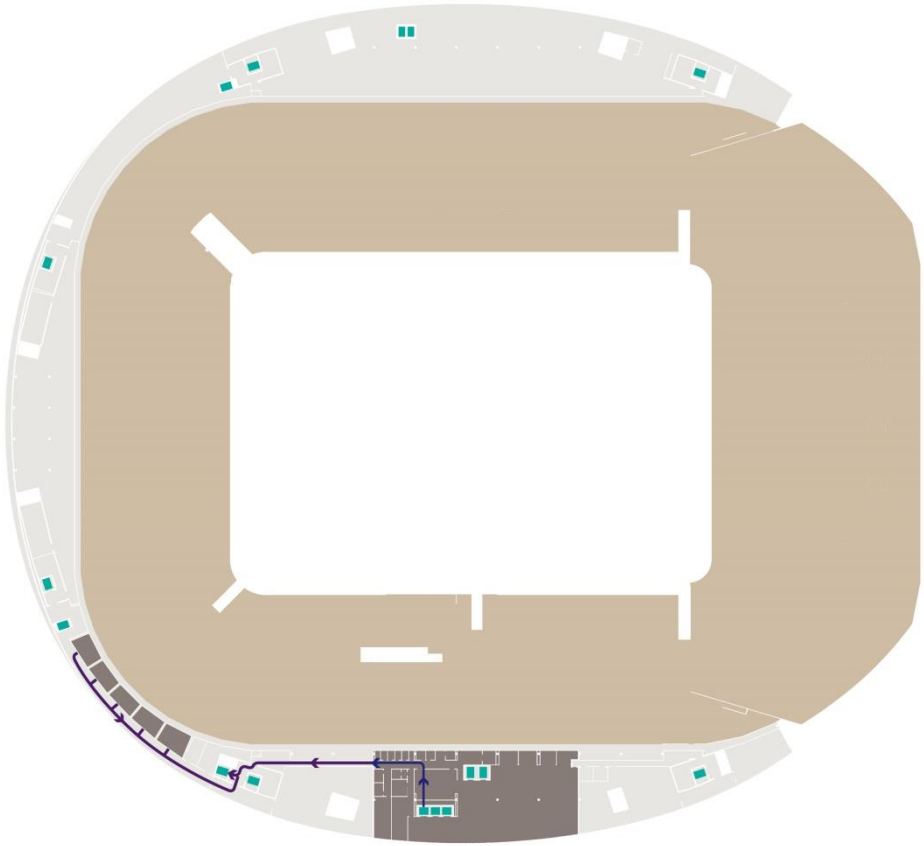

WASTE MANAGEMENT KEY

Waste collection areas

- Service yard, waste management facilities and bins
- Kitchen and bar areas
- Hospitality and boxes
- Lifts
- Player, media and office facilities
- Tottenham Experience (café, museum and retail)
- Car parking
- Stadium bowl general admission seating

Waste collection routes

- Highest quantity of waste
- Lowest quantity of waste

LEVEL 6

TOTTENHAM HOTSPUR FOOTBALL CLUB NEW STADIUM

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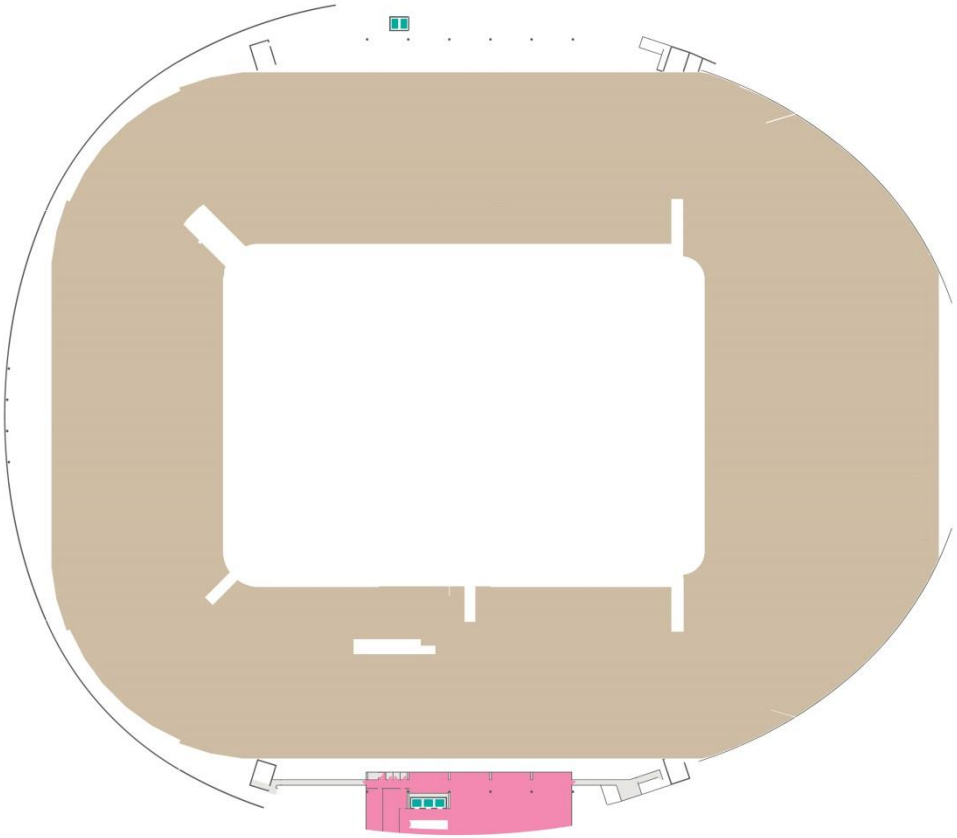

WASTE MANAGEMENT KEY

Waste collection areas

Service yard, waste management facilities and bins

Kitchen and bar areas

Hospitality and boxes

Lifts

Player, media and office facilities

Tottenham Experience (café, museum and retail)

Car parking

Stadium bowl general admission seating

Waste collection routes

Highest quantity of waste

Lowest quantity of waste

LEVEL 7

TOTTENHAM HOTSPUR FOOTBALL CLUB NEW STADIUM

OCTOBER 2014

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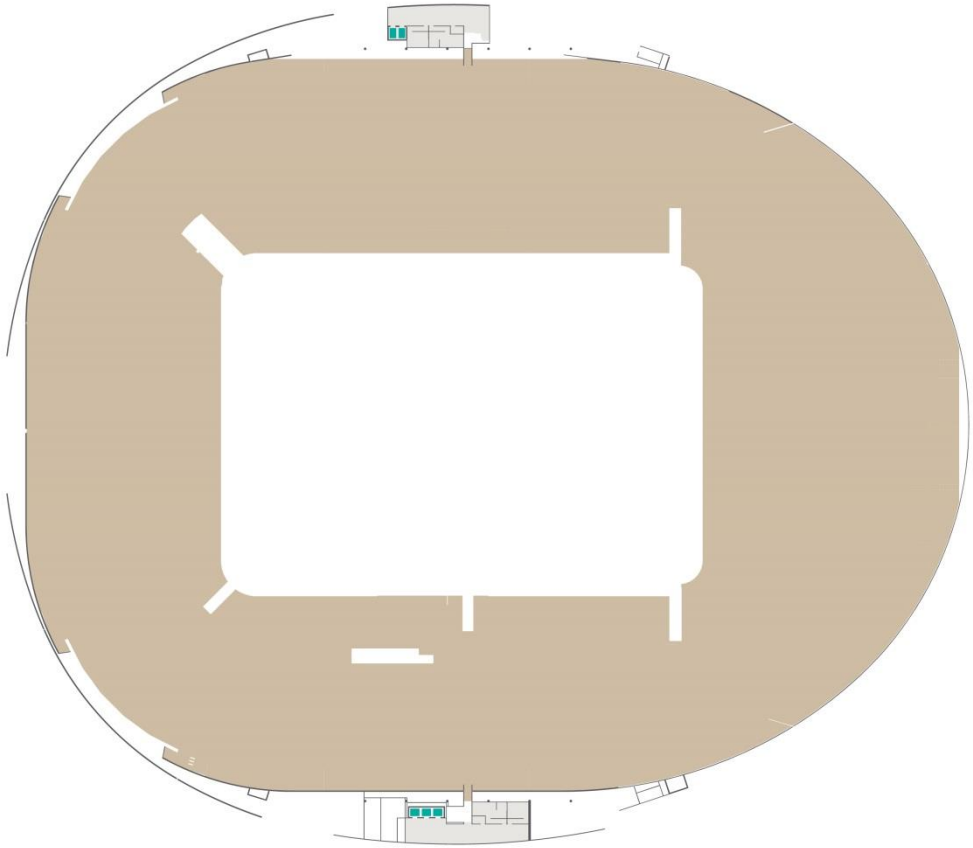

WASTE MANAGEMENT KEY

Waste collection areas

Service yard, waste management facilities and bins

Kitchen and bar areas

Hospitality and boxes

Lifts

Player, media and office facilities

Tottenham Experience (café, museum and retail)

Car parking

Stadium bowl general admission seating

Waste collection routes

Highest quantity of waste

Lowest quantity of waste

LEVEL 8

TOTTENHAM HOTSPUR FOOTBALL CLUB NEW STADIUM

OCTOBER 2014

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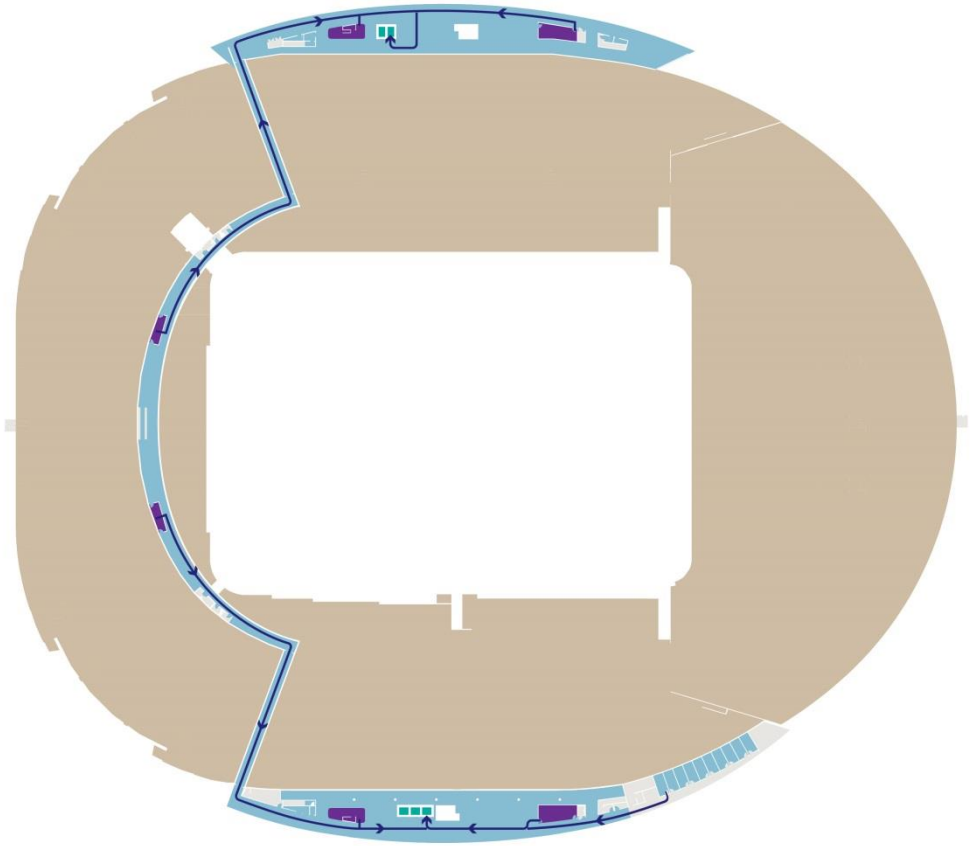

WASTE MANAGEMENT KEY

Waste collection areas

- Service yard, waste management facilities and bins
- Kitchen and bar areas
- Hospitality and boxes
- Lifts
- Player, media and office facilities
- Tottenham Experience (café, museum and retail)
- Car parking
- Stadium bowl general admission seating

Waste collection routes

- Highest quantity of waste
- Lowest quantity of waste

LEVEL 9

TOTTENHAM HOTSPUR FOOTBALL CLUB NEW STADIUM

OCTOBER 2014

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Appendix F Waste Design Note 4

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Design Note 4

Project	THFC Stadium
Subject	Spatial requirements update and strategy
Project no	031627
Date	5 August 2015

Revision	Description	Issued by	Date	Approved (signature)
01	Waste store spatial requirements update and strategy	Fergus Anderson	05.08.15	James Hobson

1 Introduction

The purpose of this document is to provide an update on the recommended spatial requirements for internal waste stores in the THFC Stadium development. The analysis presented in **Table 1** is based on the following data and assumptions;

- Occupancy figures for stand and concourse areas only based on the updated figures provided by Populous on 27.07.15;
- A waste generation rate per fan per game of 0.2498 kg, this was determined from a best practice analysis at Wembley stadium; and
- Bin sizes as follows;
  - 240L (for organic waste) : footprint of 0.92m2 including 150mm per side as require to facilitate movement
  - 1100L (for mixed recyclables and residual waste) : footprint of 2.27m2 including 150mm per side as require to facilitate movement

Levels 06, 07 and 08 have been excluded as these are primarily office areas and it is assumed these will be managed as outlined within the Operational Waste Management Strategy (OWMS) for the development. Office areas as well as media facilities, kitchens and so forth have further been excluded from the calculations below, it is assumed these areas will be managed as outlined within the OWMS for the development.

A comparison of space required (for the temporary storage of waste) and the space currently provided on plans has been made. Results are shown in Table 1. , Where a spatial requirement is significantly greater than that planned, the figure is highlighted in and thus posing a significant risk to future operations . **red**. A series of options have been outlined in section 2.1 to overcome this. A further series of options for those areas where spatial requirements are not met by provided space but lower risk is associated (highlighted in **amber**) have been provided. All other areas are deemed to be adequately serviced in terms of waste management.

It is intended that Populous and the team agree on a suitable option for those areas where risk is presented to enable effective waste management.

Table 1: Spatial requirement calculations

				Compositional breakdown			Waste generation (kg/game)			Bin numbers per game			Spatial requirement (m2)				
Land Use	**Occupancy**	**Waste Generation Rate/fan/game (kg)**	**Kg per game**	**Mixed recyclables**	**Organics**	**Residual**	**Mixed recyclables**	**Organics**	**Residual**	**Mixed recyclables**	**Organics**	**Residual**	**Mixed recyclables**	**Organics**	**Residual**	**Total floor area required (m2)**	**Provided (m2)**
Level One																	
West concourse	7607	0.2	1900	**50%**	**25%**	**25%**	950	475	475	15.8	5.7	4.8	36.01	5.27	10.80	52.08	**59.4**
Food court	3000	0.2	749	**50%**	**25%**	**25%**	375	187	187	6.2	2.3	1.9	14.20	2.08	4.26	20.54	**32**
East concourse	2858	0.2	714	**50%**	**25%**	**25%**	357	178	178	5.9	2.2	1.8	13.53	1.98	4.06	19.57	**38.3**
Away fans	2877	0.2	719	**50%**	**25%**	**25%**	359	180	180	6.0	2.2	1.8	13.62	1.99	4.09	19.70	**14.5**
Level Two																	
Away fans	143	0.2	35.7	**50%**	**25%**	**25%**	18	9	9	0.3	0.1	0.1	0.68	0.10	0.20	0.98	**0**
North stand	133	0.2	33.2	**50%**	**25%**	**25%**	17	8	8	0.3	0.1	0.1	0.63	0.09	0.19	0.91	**0**
South stand	10544	0.2	2,633.9	**50%**	**25%**	**25%**	1317	658	658	21.9	7.9	6.6	49.92	7.30	14.97	72.19	**9.6**
Level Three																	
South stand concourse	3668	0.2	916.3	**50%**	**25%**	**25%**	458	229	229	7.6	2.8	2.3	17.36	2.54	5.21	25.11	**12.6**

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				Compositional breakdown			Waste generation (kg/game)			Bin numbers per game			Spatial requirement (m2)				
Land Use	**Occupancy**	**Waste Generation Rate/fan/game (kg)**	**Kg per game**	**Mixed recyclables**	**Organics**	**Residual**	**Mixed recyclables**	**Organics**	**Residual**	**Mixed recyclables**	**Organics**	**Residual**	**Mixed recyclables**	**Organics**	**Residual**	**Total floor area required (m2)**	**Provided (m2)**
Level Four																	
North concourse (1)	1801	0.2	449.9	**50%**	**25%**	**25%**	225	112	112	3.7	1.4	1.1	8.53	1.25	2.56	12.33	**10.3**
North concourse (2)	1801	0.2	449.9	**50%**	**25%**	**25%**	225	112	112	3.7	1.4	1.1	8.53	1.25	2.56	12.33	**10.3**
South stand	2760	0.2	689.4	**50%**	**25%**	**25%**	345	172	172	5.7	2.1	1.7	13.07	1.91	3.92	18.90	**12.6**
Level Five																	
East concourse	6698	0.2	1,673.2	**50%**	**25%**	**25%**	837	418	418	13.9	5.0	4.2	31.71	4.64	9.51	45.86	**17.5**
North concourse	6104	0.2	1,524.8	**50%**	**25%**	**25%**	762	381	381	12.7	4.6	3.8	28.90	4.23	8.67	41.79	**16.6**
West concourse	6252	0.2	1,561.7	**50%**	**25%**	**25%**	781	390	390	13.0	4.7	3.9	29.60	4.33	8.88	42.81	**17.5**
Level Nine																	
Sky lounge west	350	0.2	87.4	**50%**	**25%**	**25%**	44	22	22	0.7	0.3	0.2	1.66	0.24	0.50	2.40	**3.5**
Sky lounge east	350	0.2	87.4	**50%**	**25%**	**25%**	44	22	22	0.7	0.3	0.2	1.66	0.24	0.50	2.40	**3.5**
Sky bridge (north)	120	0.2	30.0	**50%**	**25%**	**25%**	15	7	7	0.2	0.1	0.1	0.57	0.08	0.17	0.82	**0**

2 Options for Risk Mitigation

2.1 High Risk

Level Two – South Stand

Primary issue has arisen due to lack of intermediate storage areas provided, the consequence of which is that the waste generated within the South stand on Level 02 cannot be held within the stand for the entirety of the match. This means that the area will likely become heavily littered and in need of frequent servicing during game play (i.e. after kick off and half time, in addition to when fans have left). This will increase operational cost, disrupt operations and potential add to BOH congestion.

A major challenge is the fact that the South stand is located between corporate areas East and West, as such waste cannot be moved to service lifts without moving them through these areas which may detract from fan experience.

Option One

Waste is disposed of within bins in the stand and on shelves provided. Waste will be collected manually and transported to the service area on Level 00 during match play. Servicing the area at this frequency and transferring waste directly to the waste store will bypass the need for intermediate storage. If waste is not to pass through corporate areas this strategy will however necessitate that passenger lifts are used for waste transfer to Level 00.

All bins required to service the space (36 in total) will have to be stored in excess space at Level 01 and transported up via the passenger lifts.

Option Two

Provide additional storage capacity within the South Stand to accommodate anticipated waste volumes outlined in **Table 1**.

Level Four – South Stand

Whilst the difference between required space and provided space is not as great as at Level 02, the South Stand at Level 04 has been highlighted as a high risk again as this is isolated between corporate areas East and West. As the amount of waste which is anticipated to be generated in the area cannot be held in the South Stand for the entirety of the match, it must either be contained elsewhere or be serviced during match play.

Option One

Provision of additional storage capacity within the Stand, this could be bins located in the concourse which are equivalent to the short fall identified in **Table 1** for example.

Option Two

Service the bins during match play as per Option for the South Stand at Level 04.

2.2 Medium Risk

Level Two – Away Fans & North Stand

Primary issue has arisen due to lack of intermediate storage areas provided, As this is minimal this could be made up through the placement of bins throughout the concourse area. No major risk anticipated.

Level Three – South Stand

Primary issue has arisen due to lack of intermediate storage areas provided, Additional servicing will be required, suitable route to service lifts should be available to achieve this.

Level Five – North, East and West Concourses

Primary issue has arisen due to lack of intermediate storage areas provided, Additional servicing will be required, suitable route to service lifts should be available to achieve this.

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